

Exhibit A

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN FRANCISCO DIVISION

| | | |
|--------------------------------------|---|-----------------------------|
| IN RE: TFT-LCD (FLAT PANEL) |) | Master File No. C07-1827 SI |
| ANTITRUST LITIGATION |) | |
| _____ |) | MDL No. 1827 |
| |) | |
| This Document Relates to: |) | |
| |) | |
| DELL INC. and DELL PRODUCTS L.P., v. |) | |
| SHARP CORPORATION, et al. |) | |
| No. 3:10-cv-01064 SI |) | |
| _____ |) | |

EXPERT REPORT OF EDWARD A. SNYDER, PH.D.

February 23, 2012

TABLE OF CONTENTS

| | | |
|--------------|---|-----------|
| I. | QUALIFICATIONS | 1 |
| II. | ALLEGATIONS AND ASSIGNMENT..... | 2 |
| | A. Allegations concerning Dell | 2 |
| | B. Assignment | 6 |
| III. | SUMMARY OF PRINCIPAL CONCLUSIONS..... | 8 |
| IV. | ANALYTICAL FRAMEWORK..... | 12 |
| V. | LCD INDUSTRY ANALYSIS AND IMPLICATIONS FOR THE SELECTION OF ESTIMATED OVERCHARGES IN THE DAMAGES ANALYSIS..... | 13 |
| VI. | REQUIREMENTS FOR EMPIRICAL ANALYSIS OF MARK-UPS IN THE LCD INDUSTRY CONTEXT..... | 22 |
| | A. Finished LCD monitors and other large-panel products are characterized by differentiation and rapid, overlapping cycles of product introductions | 24 |
| | B. Declining relative quality over the product cycle | 29 |
| VII. | EVALUATION OF DR. RAO’S ANALYSIS OF MARK-UP AND DAMAGES | 33 |
| | A. Overview of Dr. Rao’s approach to estimating mark-ups | 35 |
| | B. Dr. Rao’s mark-up analysis fails to control for changes in product quality over product cycles..... | 36 |
| | C. Dr. Rao’s mark-up analysis fails to isolate the impact of panel cost changes on finished product price changes | 37 |
| | D. Dr. Rao’s mark-up analysis excludes much of the relevant data | 37 |
| VIII. | AFFIRMATIVE ANALYSIS OF MARK-UP AND DAMAGES | 38 |
| | A. Upstream mark-up to Dell | 40 |
| | B. Volume of sales and estimated damages | 41 |
| IX. | CONCLUDING REMARKS..... | 42 |

I. QUALIFICATIONS

1. I am Dean of the Yale School of Management and the William S. Beinecke Professor of Economics and Management. I assumed this position on July 1, 2011. From July 1, 2001 until June 30, 2010 I was the George Shultz Professor of Economics at the University of Chicago Booth School of Business and served as Dean of the School.
2. I began my professional career in July 1978 with the Antitrust Division of the U.S. Department of Justice as a Staff Economist to the National Commission to Review Antitrust Laws and Procedures. I worked as a Staff Economist in the Antitrust Division on a full- and part-time basis until 1984, working on antitrust investigations in a wide range of product markets involving manufacturers, service providers, distributors, and retailers. Since then I have worked in antitrust enforcement, conducted research on antitrust policy and business practices, taught courses in related areas, and consulted on antitrust matters.
3. I earned my M.A. in Public Policy and Ph.D. in Economics from the University of Chicago. My Ph.D. thesis focused on price fixing and examined enforcement of Section 1 of the Sherman Act by the U.S. Department of Justice; this involved reviewing over 200 price-fixing conspiracies. I began my academic career in 1982 at the University of Michigan Business School and over time was promoted to Professor of Business Economics and Public Policy. My primary expertise is Industrial Organization, which is the field of economics that deals most directly with pricing and distribution of products, the interactions among competitors, contracting practices, and antitrust issues. My research draws on relevant theory, investigates real-world behavior, and is predominantly empirical in nature. I have conducted three scholarly projects on antitrust policy and enforcement with Thomas E. Kauper, Professor of Law at the University of Michigan Law School and former Assistant Attorney General in charge of the Antitrust Division, U.S. Department of Justice. I have been an Editor of the *Journal of Law and Economics*.
4. I have analyzed economic and business issues in a rich variety of settings. I consider myself to be an expert on pricing practices, distribution of products, vertical integration and contracting, and industrial organization in general. I also consider myself to be an expert on allegations of price fixing and collusive agreements, monopolization, and other anti-competitive practices.

5. I include my curriculum vitae with my report as Appendix A. A list of cases in which I have provided testimony in recent years appears as Appendix B.

II. ALLEGATIONS AND ASSIGNMENT

A. Allegations concerning Dell

6. Plaintiff Dell alleges that the defendant manufacturers, certain affiliates and alleged co-conspirators formed a cartel to restrict competition and raise the prices of LCD panels over a period extending from at least October 2001 through at least December 1, 2006, and perhaps starting as early as 1996.^{1,2} I understand the allegations concern a conspiracy to fix the prices of LCD panels, not to fix the prices of monitors containing LCD panels (“finished LCD monitors”). Dell claims damages arising from its direct purchases of such monitors from vertically-integrated defendant firms (specifically, Samsung and LG Electronics).
7. Some defendants manufacture both LCD panels and finished LCD products. These vertically-integrated defendants produce LCD panels for their own use, for sale to other finished LCD product manufacturers, and also purchase panels from other manufacturers for incorporation into their products. Exhibit 1 lists the defendants identified by Dell and those in related litigations; it also provides the names or abbreviations used to refer to these entities subsequently in the report, as well as the locations of their headquarters, and whether the defendants manufactured or sold finished LCD products.³
8. I understand that several of the defendants in this matter have pled guilty following criminal investigations by the U.S. Department of Justice into alleged price fixing of certain LCD panels. The pleas differ in that the conspiracies cited involve different finished LCD products, time periods, and direct customers:

¹ Second Amended Complaint, *Dell Inc. and Dell Products L.P., v. Sharp Corporation et al.*, No. M:07-MD-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, August 8, 2011, pp. 1-2. While various documents use the term TFT-LCD panels, I use “LCD panels” for simplicity.

² Plaintiffs’ economics experts have used the standard term *cartel* to describe the alleged horizontal conspiracy among defendant manufacturers to fix prices. I use this term as well and I also use the terms *conspiracy* or *conspiracies* throughout my report to refer to alleged episodes of price-fixing of certain LCD products sold by the defendants or subsets of defendants during certain periods.

³ In Appendix C, I list the defendants and alleged co-conspirators named in this and related complaints. For simplicity in this report, I will refer to the combination of defendants and alleged co-conspirators as “the alleged conspirators.”

- i. Sharp's plea concerned the sales of LCD panels for monitors and laptops to Dell from April 2001 to December 2006, the sales of LCD panels for Razr mobile phones to Motorola from fall 2005 to mid-2006, and the sales of LCD panels for iPods to Apple from September 2005 to December 2006.⁴
 - ii. Hitachi Displays' plea concerned sales of LCD panels for laptops to Dell from April 2001 to March 2004.⁵
 - iii. Chunghwa Picture Tubes' plea concerned sales of LCD panels from September 2001 to December 2006 without reference to any specific panel type or customer.⁶
 - iv. LG Display's plea also concerned worldwide sales of LCD panels from September 2001 to June 2006 without reference to any specific panel type or customer.⁷
 - v. Epson Imaging Devices Corporation's plea concerned the sales of LCD panels for Razr mobile phones to Motorola from fall 2005 to mid-2006.⁸
 - vi. Chi Mei Optoelectronics' plea concerned sales of LCD panels in the U.S. and other locations from September 2001 and December 2006.⁹
 - vii. HannStar's plea concerned worldwide sales of certain but unspecified types of LCD panels from September 2001 to January 2006, without reference to customer.¹⁰
9. I understand that several defendants in these and related matters have not pled guilty or been indicted, including Mitsui, NEC, Philips, Sanyo, and the various Toshiba companies. In addition, I understand that during 2006, Samsung cooperated with the U.S. Department of Justice in its investigation of alleged anticompetitive conduct in the LCD panel industry, and sought acceptance into a corporate leniency program in return for that cooperation.¹¹

⁴ Plea Agreement, *United States of America v. Sharp Corporation*, No. M:07-cv-01827-SI, United States District Court, Northern District of California, San Francisco Division, December 8, 2008, pp. 2-3.

⁵ Plea Agreement, *United States of America v. Hitachi Displays Ltd.*, No. 3:09-cr-00247-SI, United States District Court, Northern District of California, San Francisco Division, May 17, 2009, pp. 3-4.

⁶ Plea Agreement, *United States of America v. Chunghwa Picture Tubes, Ltd.*, No. M:07-cv-01827-SI, United States District Court, Northern District of California, San Francisco Division, January 5, 2009, pp. 2-3.

⁷ Plea Agreement, *United States of America v. LG Display Co., Ltd. and LG Display America, Inc.*, No. M:07-cv-01827-SI, United States District Court, Northern District of California, San Francisco Division, December 8, 2008, p. 3.

⁸ Plea Agreement, *United States of America v. Epson Imaging Devices Corporation*, No. 3:09-cr-00854-SI, United States District Court, Northern District of California, San Francisco Division, October 9, 2009, pp. 2-3.

⁹ Plea Agreement, *United States of America v. Chi Mei Optoelectronics Corporation*, No. CR-09-1166 SI, United States District Court, Northern District of California, San Francisco Division, February 11, 2010, p. 3.

¹⁰ Plea Agreement, *United States of America v. HannStar Display Corporation*, No. 3:07-md-01827-SI, United States District Court, Northern District of California, San Francisco Division, July 22, 2010, p. 2-3.

¹¹ Letter from Michael L. Scott, U.S. Department of Justice, Antitrust Division to James L. McGinnis, "Re: Samsung Electronics Company Ltd," June 7, 2001 [SAML-815331].

10. I also understand that it has been the U.S. government's position that the defendant LCD panel manufacturers were not part of a single conspiracy, but were involved in several separate conspiracies. At the proceedings related to the guilty plea of Hitachi Displays, a representative of the U.S. government distinguished the so-called Crystal Meetings attended by the Korean and Taiwanese suppliers from a "separate conspiracy" involving Hitachi Displays, Sharp, and other unnamed alleged co-conspirators to fix the prices of LCD panels for laptops sold only to a single customer, Dell.¹²

1. Dell

11. Dell Inc., ("Dell"), founded in 1984 by Michael Dell in Round Rock, Texas, engages in the design, manufacture, sale, support of computer systems and services worldwide.¹³ Dell's products include mobile computing devices, desktop PCs, monitors, servers, and storage capacity.¹⁴ Dell's total revenue in fiscal year 2011 totaled \$61.5 billion, which included \$18.9 billion in sales of mobile computing devices, \$14.6 billion in sales of desktop PCs, and \$10.2 billion in sales of software and peripherals, including Dell-branded monitors.¹⁵ During the 1998 to 2006 period, Dell was a leading vendor in the LCD monitor market from the first quarter of 2002 through the third quarter of 2007.¹⁶

12. Dell's purchasing practices are based on accurately forecasting product demand and securing volume from suppliers based on prices that were negotiated on a monthly basis.¹⁷ Dell often sets "target prices" for suppliers on both finished monitors and LCD panels that are based on Dell's assessment of supply and demand conditions. If an offer from a supplier exceeded Dell's target prices, Dell may indicate to the vendor that the bid is uncompetitive in an effort

¹² Transcript of Proceedings Before the Honorable Susan Illston, United States District Judge, *United States of America v. Hitachi Displays Ltd.*, No. CR-09-0247, United State District Court, Northern District of California, May 22, 2009, p. 17.

¹³ "Dell Inc., Company Description," *BusinessWeek*, May 14, 2009, http://investing.businessweek.com/research/stocks/snapshot/snapshot_article.ASP?ric=DELL.O, May 2009.

¹⁴ Dell Inc. Form 10-K for the fiscal year ended January 30, 2009, pp. 2-3.

¹⁵ Dell Inc. Form 10-K for the fiscal year ended January 28, 2011, pp. 3-4.

¹⁶ "Samsung Tops Dell as World-Wide Market Leader for LCD Monitors in Q3'07; First Time Since 2002 That a Stand-Alone Brand is #1," *DisplaySearch*, November 14, 2007, <http://www.digitimes.com/displays/a20071115PR209.html>.

¹⁷ Deposition of Dennis Selman, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:10-CV-01064-SI, No. 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, September 21, 2011, (hereafter "Deposition of Dennis Selman") pp. 287-288.

to incentivize the supplier to lower its bid.¹⁸ As a large volume buyer over the period at issue, Dell had the ability to impact component panel prices.¹⁹ In many cases, suppliers would offer prices below the level set by the price target.²⁰

13. Dell often relies on multiple suppliers for a given product to ensure a stable supply of competitively priced products.²¹ In cases where multiple suppliers provided Dell's system integrators (SI) with monitor panels, Dell allocated its total demand for LCD panels across multiple suppliers based on price and quality factors.²² Dell did not always purchase panels or finished monitors from the supplier who offered the lowest bid; instead, procurement decisions were based on both price competitiveness and on the quality of the panels as determined by Dell, including the panel's "reject rate" or "failure rate".²³
14. For finished monitors, Dell's practice of negotiating prices for the monitors and their associated panels varied over time. Around 1998, the prices for panels included in finished monitors purchased by Dell were negotiated by SIs.²⁴ Dell began negotiating prices with panel manufacturers on behalf of its SIs in 1999.²⁵ During this period, Dell set target prices for both the panels and the finished monitors. Around 2003, Dell began directly purchasing LCD panels and reselling those panels to SIs, prior to purchasing the finished monitor from the SIs.²⁶ In addition, Dell purchases finished monitors from vertically-integrated companies, such as Samsung and LG, which may be sold under the Dell brand name.^{27,28,29}

¹⁸ Deposition of Piyush Bhargava, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 07-1827-SI, In the United States District Court, Northern District of California, San Francisco Division, May 3, 2011, (hereafter "Deposition of Piyush Bhargava"), p. 117.

¹⁹ Deposition of Piyush Bhargava, p. 266.

²⁰ Deposition of Sarah Zhu, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:10-CV-01064-SI, Master Case No. M-07-1827 SI, In the United States District Court, Northern District of California, San Francisco Division, November 28, 2011, (hereafter "Deposition of Sarah Zhu"), p. 231.

²¹ Deposition of Sarah Zhu, p. 118.

²² Deposition of Jens Gruenkemeier, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:10-cv-01064 SI, No. 3:07-md-1827-SI, MDL No. 1827, In the United States District Court, Northern District of California, San Francisco Division, November 11, 2011, pp. 240-242.

²³ Deposition of Dennis Selman, p. 305.

²⁴ Deposition of Dennis Selman, p. 284.

²⁵ Deposition of Dennis Selman, p. 285.

²⁶ Deposition of Dennis Selman, p. 286.

²⁷ Expert Report of Mohan Rao, Ph.D., and Supporting Materials, *Dell Inc. and Dell Products L.P., v. Sharp Corporation, et al.*, No. 10 1064, United States District Court, Northern District of California, San Francisco Division, December 15, 2011, (hereafter "Expert Report of Mohan Rao"), p. 44.

B. Assignment

15. First, I have been asked to evaluate the claims of damages to Dell based on its direct purchases of finished monitors containing LCD panels. In this regard, I have been asked to evaluate the damages analyses provided by Dell's expert economist, Dr. Mohan Rao, as well as analyses offered in related matters by Professor B. Douglas Bernheim, Professor Leslie Marx, Dr. Alan Frankel and Dr. Roy Epstein, and Dr. Gareth Macartney.
16. Second, I have been asked to offer an affirmative analysis of any damages in this matter. My damages analysis involves the following components:
 - i. Estimates of overcharges that the Plaintiff alleges stem from the effort to fix panel prices;
 - ii. Estimates of mark-up rates of these alleged overcharges by vertically-integrated manufacturers to Dell – the so-called *upstream mark-up rates*; and,
 - iii. Identifying the relevant volume of sales.³⁰
17. With respect to the first component above, I have been asked to conduct a review of aspects of the LCD panel industry, the finished LCD product industry, and the record concerning the price-fixing conspiracy as the Plaintiff alleges, with the objective of selecting estimates of alleged overcharges for my affirmative damages analysis here. I have also reviewed the expert reports of Professor Dennis Carlton, Dr. Rao, and others for the purpose of selecting which of these analyses offers the most plausible estimates of alleged overcharges.
18. A major focus of my work in this matter concerns mark-up of any alleged overcharges caused by the cartel. Thus, with respect to the second component of the damages analysis above, I have been asked to evaluate whether Dell paid higher prices on the finished LCD products it purchased as a result of the alleged LCD panel overcharges.
19. In executing my assignment, I have conducted empirical analyses as well as inquiries into several topics, including:

²⁸ Second Amended Complaint, Demand for Jury Trial, *In Re TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:10-cv-01064 SI, Master File No. M:07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, August 8, 2011, p. 9.

²⁹ Dell, "Dell Mainstream LCD, Displays E153FP, E173FP and E193FP," November 25, 2004.

³⁰ Although generally relevant as a matter of economics, I understand that the question of whether Dell passed on these overcharges to other parties is not relevant as a legal matter to the calculation of damages from direct purchases of monitors in this case.

- i. The importance of innovation and technology in the pricing of LCDs and finished LCD products, which produced strong downward trends in both LCD panel prices and prices of finished LCD products during the relevant time period;
- ii. The nature of competition among finished LCD product manufacturers, including the role of product differentiation and short product cycles;
- iii. The sales histories of LCD panels by manufacturers, including the huge shifts in the market shares among various manufacturers, the entry of new manufacturers, and the formation of joint ventures and mergers;
- iv. The nature of the distribution of LCD panels and finished LCD products, including the lengths and complexities of the distribution channels involved; and,
- v. To the extent that such information is available, the actual distribution channels for finished LCD products.

20. I have been retained by counsel on LCD-related matters since July 2008.³¹ I have directed employees of Analysis Group, Inc. (Analysis Group), an economics research and consulting firm, to assist me in this assignment. I am being compensated at an hourly rate of \$900 for time spent on the matter. In addition, I receive compensation based on the professional fees of Analysis Group. No compensation is contingent on the nature of my findings or on the outcome of this litigation.

21. I include in Appendix D a list of materials considered in the course of executing my assignment.³² These materials include ledger data produced by the defendants that contain information on prices, quantities, customers, panel characteristics, and other variables associated with the defendants' sales of LCD panels and finished LCD products; purchase data and sales data produced by a certain number of intermediaries at various points in the distribution channels of finished LCD products; industry data on LCD panel and finished LCD product prices, shipments, and revenues reported by vendors such as DisplaySearch; publicly-available information on the LCD industry and finished LCD products; and documents, depositions, and declarations produced during the course of this matter. Many of

³¹ In these related matters, I have been retained by counsel for AU Optronics, Chi Mei, Chunghwa, Epson, HannStar, Hitachi, LG Display, Mitsui, Samsung, Samsung SDI, Sanyo, Sharp, and Toshiba.

³² My preparation of Appendix D is consistent with the Stipulation and [Proposed] Order Regarding Procedures Governing Expert Discovery, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, Master File No. M07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, October 10, 2008.

these materials were also considered in the expert opinions I filed in related proceedings concerning the indirect and direct purchaser classes.³³

22. I have reviewed the expert report of Dr. Rao and any subsequent errata filed in this matter, as well as expert reports on behalf of several other plaintiffs in related litigations, and considered the expert opinions of Professor Carlton, Professor Bernheim, Professor James Levinsohn, Professor George Foster, Professor Jerry Hausman, Dr. Shukri Souri, Keith Mallinson and others in Plaintiffs' matters. I may update, refine, or revise my opinions if further relevant information is added to the record.

III. SUMMARY OF PRINCIPAL CONCLUSIONS

23. Regarding Dr. Rao's work³⁴ and my corrections to his work, I have reached the following five principal conclusions:
24. First, I have estimated the damages to Dell in this matter using sound economic principles and methods. A general statement of the formula for overcharges on finished LCD products, i.e., not taking into account downstream pass-on, is as follows:

$$\text{Gross Damages} = \text{Overcharge \%} \times \text{Volume of Sales} \times \text{Upstream Mark-up Rate}$$

25. These estimated damages are based on various elements of the formula above and related determinations:
- i. Given the record in this case concerning the alleged price fixing and based on economic analysis, Professor Carlton's estimates of average alleged overcharges from a conspiracy to fix prices of LCD panels constitute the most plausible input into the damages analysis. As a result, I have adopted the estimated overcharges in his report in my affirmative damages analysis.³⁵
 - ii. I estimate the average upstream mark-up rate to be 90 percent for finished monitors directly purchased by Dell. I derive that estimate using the methodology

³³ Expert Report of Edward A. Snyder, Ph.D., and Supporting Materials, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. C07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, July 22, 2011 (hereafter "Snyder Report, July 2011").

³⁴ Of note, Dr. Rao uses the term "pass-through" or "pass-on," which are the general terms in antitrust for decisions made by entities to adjust their prices when they experience changes in costs. In the context of vertically-integrated manufacturers making internal transactions of panels and then selling finished LCD products to direct purchasers, I will generally refer to this as "mark-up" instead of pass-on in my report.

³⁵ Expert Report of Dennis W. Carlton, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. C07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, February 23, 2012, (hereafter "Expert Report of Dennis W. Carlton"), pp. 6-10.

- best suited for empirical inquiry given the most important features of the LCD panel and finished LCD product industries. The application of this methodology is also supported by the economics literature on pass-on. I apply this mark-up rate to Dell's purchases.
- iii. The appropriate volume of sales at issue includes computer monitors directly purchased by Dell from defendants LG and Samsung. I have calculated the total volume of sales at issue in this matter during the period from October 2001 to 2004 (the "damages period" alleged by Dell).
 - iv. The estimated Gross Damages to Dell, therefore, takes into account the estimated overcharges, the average estimated mark-up rate, and the finished LCD monitor purchases (volume of sales at issue) by Dell.
26. Second, I am aware of Dell's allegations concerning efforts by the defendant LCD manufacturers to fix prices of LCD panels over the damages period. I have not been asked to assess directly whether these efforts were effective in raising some LCD panel prices at points in time. However, standard analysis of the LCD panel and finished LCD product industry indicates that there are many factors that would make adherence to a consistent, comprehensive price-fixing conspiracy difficult. These factors include, among others, the huge numbers of finished LCD products, the extent of product differentiation, the high frequency of new product introductions, the diverse array of purchasers of finished LCD products, the fact that some defendant manufacturers are vertically-integrated into the production of finished LCD products, the huge shifts in the market shares among defendants, and the changing identities of LCD manufacturers during the relevant time period.
27. In the presence of these factors, it is difficult to adjust the terms of a price-fixing agreement, monitor behavior, and thus assure consistent adherence to a comprehensive agreement to fix LCD panel prices. Per my assignment, I have reviewed the opinions of Dr. Rao and Professor Carlton concerning estimated overcharges and their supporting analyses. Especially in light of Dr. Rao's conclusion that the price-fixing efforts resulted in the imposition of high average overcharges (in the range of 23 to 26 percent), Dr. Rao's analysis is striking in its lack of industry analysis that is typically standard in economic analysis of price-fixing cases.³⁶ He does not, for example, either document or address the significance

³⁶ Discussions of relevant characteristics in industries where cartels have attempted to fix price include: Stigler, George J., "A Theory of Oligopoly," *Journal of Political Economy*, Vol. 72(1), February 1964; Levenstein, Margaret C. and Valerie Suslow, "What Determines Cartel Success?" *Journal of Economic Literature*, Vol. 44(1), March 2006; Motta, Massimo, *Competition Policy: Theory and Practice*, Cambridge University Press New York, 2004; Hay, George A., and Daniel Kelley, "An Empirical Survey of Price Fixing Conspiracies,"

of large shifts in market shares of defendants and non-defendants, huge waves of new product introductions, and short product cycles in the context of a supposedly well-functioning price-fixing agreement that imposed large average overcharges. Nor does Dr. Rao apply standard economic analysis to the facts and issues associated with the prominent role of vertically-integrated firms in the LCD panel industry. By contrast, Professor Carlton's opinions concerning estimated overcharges are supported by standard industry analyses. Therefore, as an economist, I conclude that I should adopt Professor Carlton's estimates of overcharges for my damages analysis.

28. Third, I conclude that the estimates of the mark-up rate offered by Dr. Rao do not isolate mark-ups caused by cost increases and, therefore, do not accurately measure mark-up behavior between vertically-integrated LCD manufacturers and Dell. As explained in Section VI, there are fundamental differences in product quality among LCD panels. These quality differences, which are correlated with costs, are of central importance in the marketplace. The quality differences, in principle, could be accounted for in Dr. Rao's results that combine data on different finished LCD products and identify how their prices and costs change over time. However, Dr. Rao has failed to account for the effect of *product cycles* on mark-ups.
29. As documented in Section VI, the prices of finished LCD products often fall over their relatively short product cycles for reasons that have nothing to do with decreases in costs. Rather, the demand for new finished LCD products typically peaks at (or near) the beginning of their product cycles, as the product is most differentiated from competing offerings. By contrast, relative quality falls late in product cycles, when other new finished LCD products – often with improved functionalities – are introduced. As a result, it is often the case that prices for finished LCD products fall within their product cycle and do so relative to observed cost changes. Any sound empirical inquiry into mark-up decisions must, therefore, account for the independent effects of changes in relative product quality due to product cycle effects on prices. Dr. Rao's method does not do so and, as a result, he generates overestimates of mark-up with his empirical method.

Journal of Law and Economics, Vol 17(1), April 1974; Scherer, F.M, and David Ross, *Industrial Market Structure and Economic Performance*, Houghton Mifflin, Company, Boston, 1990; Boyer, Marcel, and Rachidi Kotchoni, "The Econometrics of Cartel Overcharges," *CIRANO*, March 2011.

30. The unifying insight here is that differences in demand, due either to quality differences or changes in the product's relative appeal over time, will affect prices independent of costs. These effects must be distinguished from the effect of cost on price. Although Dr. Rao accounts for certain effects of product quality in determining finished monitor prices, he does not control for the product cycle's effect on price. In missing this central feature of the industry, Dr. Rao overstates the actual effects of changes in costs on changes in prices. This critical insight is described more formally in the expert opinion of Professor James Levinsohn, which supports my own approach and conclusions.
31. Dr. Rao's mark-up analysis is flawed for other reasons. In particular, Dr. Rao fails to incorporate all available data in his analysis. Although he estimates damages for the limited time period of the fourth quarter of 2001 to the fourth quarter of 2004, data are available for his mark-up analysis through at least the fourth quarter of 2006. The inclusion of these extra data reduces his mark-up estimates. Furthermore, as demonstrated in Professor Carlton's report, Dr. Rao's overcharge model yields negative overcharges in the years 2005 to 2006, though he has chosen not to present damages for this period.³⁷
32. Furthermore, Dr. Rao's analysis uses panel costs, as opposed to total manufacturing costs in his mark-up regression. However, there are many other determinants of the price of finished monitors such as the costs of other components that are incorporated into a monitor. Given that Dr. Rao fails to adequately control for these other determinants of the price of finished monitors, and given that these other factors are likely positively correlated with panel costs, this will result in upward bias in his estimates, or, in other words, unreliable results that overstate mark-up.
33. Fourth, I conclude that the most reliable estimates of mark-up rates are derived using the *first-differences method* that includes a time trend. This method correctly isolates mark-up in the context of price changes within a product cycle, which are influenced by changes in relative quality driven by rapid technological improvement, short product cycles, and product differentiation, as well as other factors. I should note that the differences between these

³⁷ Deposition of Mohan Rao, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:10-CV-01064-SI, No. 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, January 26, 2012, (hereafter "Deposition of Mohan Rao"), p. 126; Expert Report of Mohan Rao, pp. 41-42.

mark-up estimates, which account for the factors identified above, and those derived by Dr. Rao are not huge. But these differences are important in the overall estimate of damages.

34. Fifth, I conclude that a sound damages analysis should consider the different numbers of strong downward price trends in both LCD panel prices and finished LCD product prices. Thus, it avoids problems associated with a host of factors that may not be observed directly in the available data. This method has been used extensively in economic analyses of the related issue of evaluating pass-on decisions of costs. The effect of applying the correct method is to reduce Dr. Rao's erroneous findings of 100 percent mark-up down to a mark-up of 92 percent.

IV. ANALYTICAL FRAMEWORK

35. In this brief section, I highlight some of the important aspects of my analytical framework. Consistent with the approach I have outlined previously, there are three conditions for potential damages and impact to Dell discussed in this report. First, the relevant direct purchaser must have paid illegal overcharges on LCD panels as a result of the conspiracy, and, second, at least some part of those overcharges must have been passed on by the integrated defendant manufacturer (in total or in part) in the price of the finished monitor when sold to Dell. In other words, the manufacturers did not decide to absorb the overcharges when transforming the LCD panel into a finished product. If these two conditions are met for Dell, then it paid higher prices in the actual world as a result of the alleged conspiracy or conspiracies. If, however, either of these conditions is not satisfied, then Dell was not damaged by the alleged conspiracy or conspiracies.
36. As a matter of economics, it is also relevant to consider the third condition related to damages, whether the Plaintiff passed on some or all of the overcharges to their customers. Because the Plaintiff resells finished LCD products, it may have adjusted prices to account for overcharges and thereby offset any Gross Damages. I do not conduct this inquiry in this case, as Counsel has indicated it may not be a relevant legal consideration for evaluating damages associated with direct purchases.
37. As indicated above, I incorporate into my analysis important characteristics of the LCD panel and finished LCD product industries. My selection of estimates for my damages analysis is

based in large part on my understanding of various industry factors and my review of Professor Carlton's and Dr. Rao's reports. The most important analytical issue is to account for factors such as the effect of product cycles on prices influenced by the pattern of technological innovation and resulting introduction of new, competing products. The quality of products at issue differs, and the relative appeal of each product typically declines over time. Therefore, the methods selected to evaluate mark-up must distinguish the effects of changes in costs on changes in prices from the effects of these other factors, some of which are correlated with time. Methods should control for changes in relative quality and competition over time and across products and thereby isolate the effect of costs on prices. Failing to control for these factors, as I explain, is almost certain to yield overestimates of the mark-up.

V. LCD INDUSTRY ANALYSIS AND IMPLICATIONS FOR THE SELECTION OF ESTIMATED OVERCHARGES IN THE DAMAGES ANALYSIS

38. One aspect of my assignment is to select estimated average overcharges for my overall damages analysis given my review of Professor Carlton's and Dr. Rao's reports and various industry conditions. In part, my selection is guided by whether efforts to fix prices on LCD panels would result in substantial, systematic, and sustained overcharges, or alternatively, if characteristics of the LCD panel and finished LCD products industries would make it difficult to achieve those objectives. Such standard economic analysis can generate insights into the nature of the costs of adjusting the terms of a price-fixing agreement, monitoring behavior, and maintaining adherence to the agreement. This analysis in turn is valuable in assessing, from the point of view as an economist, the plausibility of the alternative overcharge estimates.
39. Underlying the standard industry analysis is the straightforward conceptual framework that while price fixing may yield benefits for those involved, there are also costs in terms of reaching and maintaining price-fixing agreements.³⁸ Those costs vary with characteristics of

³⁸ Stigler, George J., "A Theory of Oligopoly," *Journal of Political Economy*, Vol. 72(1), February 1964, p 46; Levenstein, Margaret C. and Valerie Suslow, "What Determines Cartel Success?" *Journal of Economic Literature*, Vol. 44(1), March 2006, p. 45; Motta, Massimo, *Competition Policy: Theory and Practice*, Cambridge University Press, New York, 2004, pp. 139-140; Hay, George A., and Daniel Kelley, "An Empirical Survey of Price Fixing Conspiracies," *Journal of Law and Economics*, Vol 17(1), April 1974, p. 15; Scherer, F.M, and David Ross, *Industrial Market Structure and Economic Performance*, Houghton Mifflin,

the products involved as well as other industry characteristics. In general, whether the collusion involves an explicit agreement, an implicit agreement, or some combination, the relevant costs are lower when there are fewer parties to the agreement and, importantly, when there is stability in the marketplace in terms of products, prices, market shares, and other factors. In addition, if some of those involved in the collusion are vertically integrated, the costs of gaining adherence to the agreement are likely to rise given that vertically-integrated firms sell different products to a broader set of customers. Such costs also increase when technology drives changes in product offerings, which is manifest in frequent product introductions as well as substantial changes in product quality over the course of product cycles. In general when the relevant costs increase, it becomes increasingly difficult to assure consistent adherence to a comprehensive price-fixing agreement, especially when the objective is to impose high illegal overcharges.

40. Without reviewing fully my July 2011 report concerning the costs of reaching and sustaining a comprehensive agreement, here I highlight (i) the dramatic changes in the identities of LCD panel manufacturers during the relevant period, and (ii) the substantial shifts in market shares among LCD panel manufacturers. I then discuss the importance of (iii) product differentiation, (iv) the short product cycles, and (v) vertical integration.
41. First, over the course of the alleged efforts to fix prices of LCD panels, the industry experienced dramatic changes in the identities of competitors due to the entry of new firms, the exit of firms, and other events, including mergers and joint ventures. As summarized in Exhibit 2, the period 1996-2006 was anything but stable in terms of the supply side of the LCD panel industry. New entrants included defendant manufacturers Chunghwa, AUO, CMO, and HannStar as well as non-defendant manufacturers SVA-NEC, Toppoly, and InfoVision.^{39,40} The share of Taiwanese manufacturers increased, while the defendant firms

Company, Boston, 1990, pp. 277,-315; Boyer, Marcel, and Rachidi Kotchoni, "The Econometrics of Cartel Overcharges," *CIRANO*, March 2011.

³⁹ As discussed in my previous report, entry involves substantial investments. See Deposition of Scott Birnbaum, Samsung 30(b)(6), *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, February 19, 2009, (hereafter "Deposition of Scott Birnbaum"), p. 177 ("So the – the process for production capacity is pretty complicated. You – you need to look several years into the future because each new fab costs multiple billions of dollars to put in place."); Hara, Yoshiko, "Sharp Takes Lead in Next-gen LCD Fab Race," *EETimes.com*, August 7, 2006, <http://www.eetimes.com/electronics-products/other/4086111/Sharp-takes-lead-in-next-gen-LCD-fab-race>, August 7, 2006, visited on July 22, 2009 ("Sharp invested ¥150 billion (about \$1.3 billion) to

located in Japan lost share rapidly. Dr. Rao's analysis of the industry and the efforts to fix LCD panel prices gives virtually no weight to this evidence whereas Professor Carlton did evaluate the implications of the changing identities of the LCD manufacturers.⁴¹

42. Second, as summarized in Exhibits 3.1-3.3, the market shares of the defendant manufacturers shifted dramatically within the period of alleged price-fixing efforts. For example, Sharp's share of monitor panel revenues was roughly 10 percent in 2000, but by 2006, its share dwindled to almost zero. Hitachi Displays' share of notebook panel sales was 14 percent in 1999, but by 2006, that share was less than one percent. AUO's share of television panel sales increased from 2003 to 2006, whereas Sharp's share decreased over the same period. In addition, as summarized in Exhibits 4.1-4.3, there were substantial changes in market shares among defendant and non-defendant manufacturers. For example, Exhibit 4.1 reports non-defendant revenue shares for LCD panels for use in monitors and shows that non-defendants had a combined revenue share of less than 45 percent in 1999. However, this revenue share fell to less than 15 percent in 2006.
43. The costs of securing adherence to the price-fixing terms are greater when particular firms are gaining sales to important customers at the expense of others. Exhibit 5, which shows Dell's sourcing of LCD panels for use in their notebook computers from 2003 through 2006, indicates that the shares of sales shifted among different LCD panel manufacturers: Sharp supplied 17 percent of Dell's LCD notebook panels in 2003 but only three percent in 2006. AUO, on the other hand, did not supply any LCD notebook panels for Dell in 2003, but supplied 19 percent of this line of business in 2006.
44. Changes in market shares, along with entry and exit, are typical starting points for standard industry analyses of price-fixing agreements. Dr. Rao's report does not explain how his estimated overcharges are consistent with the substantial changes in the identities of LCD

build the 8G Fab2. Its initial monthly capacity is 15,000 glass substrates. The capacity will be doubled to 30,000 substrates monthly by next March.”). The costs of organizing the price-fixing increase when demand for LCD panels is low. See Carlton, Dennis W., and Jeffrey M. Perloff, *Modern Industrial Organization, Fourth Edition*, Addison Wesley, 2005, p. 139. In general, the combination of high fixed costs and low marginal costs that characterize the manufacturing of LCD panels increase the difficulty of ensuring that various parties to a price-fixing agreement adhere to its terms.

⁴⁰ As covered in my damages report for the indirect purchaser class, the manufacture of LCD panels involves substantial investments.

⁴¹ Expert Report of Dennis W. Carlton, pp. 2-5.

manufacturers, the huge shifts in market shares, and the shifts in shares to various customers.⁴² Professor Carlton, however, did evaluate the implications of such factors when evaluating the Plaintiff's claims.⁴³

45. Let me now address the role of *product differentiation* of LCD panels and finished LCD products. The LCD panel and finished LCD product industries represent a striking contrast to a simple and stable framework in which the costs of securing adherence to a comprehensive price-fixing agreement are low. Indeed, the distribution channels into which LCD panel manufacturers sell are wide and complex, and the many finished LCD products sold are subject to rapid technological change.

46. The purchasers of LCD panels include numerous and varied manufacturing firms and distributors, including original equipment manufacturers (OEMs), original design manufacturers (ODMs), contract manufacturers and systems integrators, and electronic parts distributors.⁴⁴ OEMs such as Apple, Dell, and Lenovo coordinate the creation of finished LCD products sold under their brand names. OEMs often contract out the actual assembly of their finished LCD products to ODMs such as BenQ, Compal, and Quanta, or to contract manufacturers.⁴⁵ ODMs may also sell finished LCD products under their own brand

⁴² Although Dr. Rao has concluded that the combined market share of conspirators was high during the alleged conspiracy period, he does not discuss the shifts in shares between participants in the alleged conspiracy. Expert Report of Mohan Rao, p. 25.

⁴³ Expert Report of Dennis W. Carlton, pp. 2-5, 84-90, 75-81.

⁴⁴ Declaration of Michael Blashe In Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009, p. 4 ("The TFT-LCD panels manufactured by TMD (and formerly Toshiba Corporation) and sold to TAEC [Toshiba Electronics] are resold by TAEC to customers such as Original Equipment Manufacturers ("OEMs"), Original Design Manufacturers ("ODMs"), contract manufacturers and system integrators in the United States, Puerto Rico, and Mexico, for incorporation into various finished products such as notebook computers, ATMs, car navigation systems, cellular phones and mobile music devices."); Declaration of Tadashi Yamada In Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009, p. 2 ("HDP [Hitachi Displays] manufactures and sells TFT-LCD panels to several types of customers, including systems integrators, contract manufacturers, distributors, and original equipment manufacturers ("OEMs"), for incorporation into finished TFT-LCD products.").

⁴⁵ Declaration of Yoong-Ki Min In Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, June 29, 2009, (hereafter "Declaration of Yoong-Ki Min, June 29, 2009") p. 6 ("OEMs are companies that brand and distribute products that are typically manufactured by contract manufacturers/system integrators. Some manufacturers also manufacture their own finished electronic products for sale under their own brand to electronics wholesalers,

names.⁴⁶ Electronic parts distributors, such as Arrow, Avnet, and Bell Micro, purchase LCD panels from panel manufacturers and re-sell them to ODMs and contract manufacturers.⁴⁷ When an OEM decides to use LCD panels from a particular LCD panel supplier in its finished LCD products, the OEM may purchase LCD panels from a supplier and have them shipped to an ODM or contract manufacturer for incorporation into finished LCD products. Alternatively, the OEM may have its ODM or contract manufacturer purchase the panels from a supplier, and subsequently purchase the finished LCD products from the ODM or contract manufacturer.⁴⁸

47. As is commonly understood, LCD panels are highly differentiated based on use and several important product characteristics. Two important dimensions of differentiation are panel size and the underlying panel technology. Small LCD panels, used in cellular phones, cameras and other portable devices, include both thin-film transistor panels (“TFT-LCDs”) as well as super-twisted nematic panels (“STN-LCDs”). Medium and large LCD panels (greater than 10”) are typically used in notebook computers, computer display monitors and televisions. TFT-LCD panels are manufactured with the transistors.⁴⁹ STN-LCD panels employ an older technology to control the display’s pixels.⁵⁰ TFT-LCDs employ a matrix of thin-film transistors (TFTs) for more precise control of individual pixels.⁵¹ Other technologies, such

retailers and consumers. For example, in the manufacture of laptops, OEM companies include Dell, Lenovo, and Apple”).

⁴⁶ Pick, Adam, “Working with ODMs: Growth, Benefits and Challenges,” *Electronics Manufacturing Asia*, July 1, 2004, <http://www.emasiamag.com/article-248-workingwithodmsgrowthbenefitsandchallenges-Asia.html>, visited on July 27, 2009 (“ODMs (original design manufacturers) provide design and manufacturing services to OEMs, and at times sell products under their own brand name. Among leading ODMs are Quanta, BenQ and Compal.”).

⁴⁷ Declaration of Yoong-Ki Min, June 29, 2009, p. 6 (“...electronic parts distributor companies include Avnet, Bell Micro, and Arrow.”).

⁴⁸ Declaration of Yoong-Ki Min, June 29, 2009, pp. 6-7 (“...Dell could purchase a panel directly from LG Display or indirectly from Dell’s system integrator (e.g., Quanta) for use in manufacturing Dell products.”); Deposition of Tim Tierney, HP 30(b)(6), *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:07-md-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, April 5, 2011 (hereafter “Deposition of Tim Tierney, April 5, 2011”), pp. 31-33.

⁴⁹ During the period from 2000 to 2010, large TFT-LCD panels used amorphous silicon (“a-Si”) TFTs, while smaller panels used for mobile phones used a-Si TFTs and low-temperature poly-silicon (“LTPS”) TFTs. LTPS TFTs are more costly to produce, but have some specific advantages for electronic devices needing a small TFT-LCD panel.

⁵⁰ den Boer, Willem, *Active Matrix Liquid Crystal Displays, Fundamentals and Applications*, Newnes, 2005, pp. 2-3.

⁵¹ Lee, Jiun-Haw, David N. Liu, and Whin-Tson Wu, *Introduction to Flat Panel Displays*, Jon Wiley & Sons Ltd., 2008, pp. 47-48. For LCDs, the application of electricity to the crystals is typically performed via two different

as organic light-emitting diodes (OLEDs), have been increasingly used in applications requiring small panels (i.e., mobile phones) during the past decade.⁵² Certain types of flat panel display technologies can only be used in certain applications. For example, small panel application such as mobile phones and PDAs do not require high resolution images and can use STN-LCDs, while large panel applications like monitors and television must use TFT-LCDs to achieve the necessary image quality.⁵³

48. LCD panels are further differentiated by several dimensions including: (i) thinness, (ii) weight, (iii) color quality, (iv) power consumption, (v) brightness, (vi) aspect ratio, and (vii) viewing angles.⁵⁴ Adjustments and improvements to size, resolution, brightness, contrast ratio, and other characteristics of LCD panels are nearly continuous. Given product differentiation on these dimensions, panels are frequently designed and built according to a particular customer's specifications.⁵⁵ The numerous and varying characteristics of the

techniques, or "driving schemes." TFT-LCDs rely on an active matrix ("AM") driving scheme. The passive matrix ("PM") driving scheme is an older approach that results in a lower contrast display, as it does not allow for precise control of the individual pixels that make up the LCD. STN LCDs rely on a passive matrix driving scheme.

⁵² DisplaySearch data, DISP_LCD-000001.xls.

⁵³ Expert Report of Shukri Souri, Ph.D., *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:07-md-1827SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, February 23, 2012, (hereafter "Expert Report of Shukri Souri"), pp. 14-16. See also, den Boer, Willem, *Active Matrix Liquid Crystal Displays, Fundamentals and Applications*, Newnes, 2005, pp. 19-20.

⁵⁴ Expert Report of Shukri Souri, pp. 19-21. See also, Declaration of Yoong Ki Min, June 29, 2009, p. 5 ("LG Display designs and manufactures its panels to meet the various size and performance specifications of its customers, including specifications relating to thinness, weight, resolution, color quality, power consumption, response times and viewing angles."); Declaration of Michael Blashe In Support of Defendants' Joint Opposition to Direct Purchaser plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009, (hereafter "Declaration of Michael Blashe, June 25, 2009"), pp. 4-5 ("Specifications from customers generally are of three types: mechanical, electrical and optical. The customized design will typically need to meet customer requirements with respect to features such as mechanical thickness, brightness and aspect ratio."). However, despite this customization, customers often source LCD panels from more than one qualified manufacturers. Declaration of Michael Blashe, June 25, 2009, p. 6 ("Larger companies may have several qualified suppliers for a particular customized product and purchase TFT-LCD panels from each of these suppliers.").

⁵⁵ Declaration of Yoong-Ki Min, June 29, 2009, p. 5 ("Approximately 80% of notebook panels, 50% of monitor panels, and 100% of TV panels are customized for each customer."); Declaration of Marshall Pinder in Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M:07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009 (hereafter "Declaration of Marshall Pinder, June 25, 2009"), pp. 1-2 ("In my experience, the TFT-LCD panels sold to large OEM customers are always customized to particular specifications of each OEM... although it has varied over time, over the past several years, and at least since 2001, customized TFT-LCD panels constitute more than 80% (either by revenue or quantity) of SMA's TFT-LCD panel sales."); Declaration of Kevin Yang in Support of Defendants' Opposition

relevant LCD panels raise the costs of maintaining a comprehensive agreement.⁵⁶ These types of differentiation increase the costs of assessing whether actual prices adhere to the collusive prices. Shifts among the relative importance of types of LCD panels also contribute to the challenge.

49. Given this extent of product differentiation, it is not surprising that the *product cycles* of particular LCD panel models tend to be short, many less than one year.⁵⁷ Even LCD panels that have the same basic characteristics, such as size, resolution, and application of intended use, undergo frequent revisions that often result in models replacing one another sequentially.⁵⁸
50. The high frequency with which LCD panel models change increases the costs of maintaining adherence to a comprehensive price-fixing agreement. As products come onto the market, it is potentially challenging to detect and distinguish departures from agreed upon prices. Similar to the problems associated with customized products, product turnover complicates enforcement of the cartel, increasing the burden associated with tracking relevant products. This in turn make departures from any agreed upon prices more profitable as compared to

to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M:07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, June 18, 2009, p. 2 ("A significant volume of the panels manufactured and sold by CMO are customized."); Declaration of Tadashi Yamada in Support of Defendants' Joint Opposition to Direct Purchaser Plaintiffs' Motion for Class Certification, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M:07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009 (hereafter "Declaration of Tadashi Yamada, June 25, 2009"), p. 3 ("Customized panels, meaning panels designed according to a customer's specifications, comprise over 95 percent of HDP's production and sales."); Declaration of Michael Blashe, June 25, 2009, p. 4 ("The majority of TFT-LCD panels sold by TAEC [Toshiba Electronics] are unique and customized to a customer's specifications.").

⁵⁶ Motta, Massimo, *Competition Policy: Theory and Practice*, Cambridge University Press, New York, 2004, p. 146; Carlton, Dennis W., and Jeffrey M. Perloff, *Modern Industrial Organization, Fourth Edition*, Addison Wesley, 2005, p. 135.

⁵⁷ See the discussion in Section VI below, and especially discussion regarding Figures 1-4 included therein. See also Deposition of L. Thomas Heiser, HEDUS 30(b)(6), *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, March 31, 2009, pp. 108-109 ("Q: Okay. Is it your experience that the product lifecycle for an LCD-TFT panel can be relatively short? A: It can be extremely short. Q: Yeah. You can develop it and it can be sold for a couple of months? A: It's usually longer than that [...] Q: But it can be as short as a year? A: Yes.").

⁵⁸ Semenza, Paul, "Improvements in TFT-LCD Performance: Better Picture, Thinner, and Lower Power," *Display Marketplace*, September 2010.

circumstances when product cycles are long, products are less differentiated, and enforcement is less costly.⁵⁹

51. Substantial technological change and rapidly declining prices, in part due to gains in the manufacturing process, characterize and explain the huge numbers of finished LCD products and their short product cycles.⁶⁰ This further complicates monitoring of price agreements. Prices may decline simply because of technological changes. Distinguishing departures from these “naturally occurring” price changes is a necessary precondition to any effective enforcement mechanism. Unlike an industry in which prices are stable and reductions from agreed upon prices can be identified, the rapidly declining prices of LCD panels during the period increased the costs of identifying departures from agreed upon prices. Indeed, evidence presented in recent proceedings reflected this difficulty.⁶¹
52. Another relevant feature of the finished LCD product industry is that several important LCD panel manufacturers during the relevant period were vertically integrated into the production of finished LCD products. These vertically-integrated firms manufacture and/or sell finished LCD products under their own brand names, such as Sharp, Toshiba, Hitachi and Samsung. These vertically-integrated firms played significant roles in the finished LCD product industry during the relevant period and must be accounted for in any appropriate analysis of injury and damages to indirect purchasers of finished LCD products. Further complicating the effort to monitor adherence to any alleged agreement, some vertically-integrated manufacturers use their own LCD panels in their finished LCD products, but may also source panels from other manufacturers.⁶²

⁵⁹ Hay, George A., and Daniel Kelley, “An Empirical Survey of Price Fixing Conspiracies,” *Journal of Law and Economics*, Vol 17(1), April 1974, p. 15; Motta, Massimo, *Competition Policy: Theory and Practice*, Cambridge University Press-New York, 2004, p. 146.

⁶⁰ Expert Report of Shukri Sourì, pp. 45.

⁶¹ Transcripts of Proceedings, *United States of America v. AU Optronics Corporation, et al.*, No. Cr. 09-00110 SI, In the United States District Court, for the Northern District of California, Volume 14, February 1, 2012, p. 2329.

⁶² See Exhibits 9 and 10 from my July 2011 report. See also Deposition of Junnosuke Tojo, Toshiba Corporation 30(b)(6), *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M07-1827, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, March 31, 2009 (hereafter “Deposition of Junnosuke Tojo, March 31, 2009”), pp. 39-40 (“Q: But currently TACP does not sell any televisions utilizing LCD displays with LCD display panels supplied by Toshiba Matsushita? A: It does not sell. [...] Q: Currently which manufacturers supply LCD displays to TACP for use in manufacture of televisions? A: As of right now, the two companies supply LCD displays: Samsung and LG.”). Other vertically-integrated manufacturers also source panels from other manufacturers. Deposition of Hiroshi Ishimura, Toshiba 30(b)(6), *In Re: TFT-LCD*

53. The presence of vertically-integrated firms as both participants in the alleged LCD panel conspiracy or conspiracies, and competitors with other third party customers of finished goods, represents a further challenge to a conspiracy. A comprehensive conspiracy would have to maintain adherence to LCD panel prices as well as adherence to a vast array of finished LCD product prices that include analogous overcharges. I understand that the allegations concern a conspiracy to fix the prices of LCD panels, not to fix the prices of finished LCD products themselves.^{63,64} Nevertheless, to achieve consistent and substantial overcharges would require, at a minimum, some means of ensuring that vertically-integrated firms would maintain the agreement.
54. My discussion of several important factors here that are typical of a standard economic analysis of a price-fixing conspiracy is not intended to indicate that there were no efforts to fix LCD panel prices nor that such efforts were completely ineffective. As indicated, my assignment includes the task of selecting estimated overcharges for my overall damages analysis. As an economist with expertise in price-fixing agreements, I view such a review as relevant in this regard. The LCD panel industry characteristics, including the changing identities of industry participants, shifting market shares, product differentiation, short product cycles, and the extent of vertical integration in manufacturing, are more consistent with the overcharges measured by Professor Carlton, who finds an overcharge of 0.4 percent of large panel prices.⁶⁵ These overcharges are consistent with facts about the industry and

(*Flat Panel*) *Antitrust Litigation*, No. M 07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, March 27, 2009, pp. 45-46 (“Q: Where else did Toshiba Corporation get its LCD panels if not from TMD? [...] A: Again, I will answer to the best of my recollection. They would be Samsung, LG, Sharp, Chimei, AU [...] there were probably other companies as well, but that’s about all I can think of right now.”); Deposition of Junnosuke Tojo, March 31, 2009, pp. 40-41 (“Q: Other than Samsung or LG, has – have there been any other suppliers of LCD panels that have been used by TACP in the manufacture of televisions? [...] A: You mean go back in time? [...] Q: Yes. A: Yes, there were. Q: And who were those suppliers? A: For the television that TACP manufactured, what kind of LCD display we used, other than Samsung and LG, there were four companies, which are: Sharp, AUO, CMO, IPS Alpha – TACP used other than Samsung and LG.”); Deposition of Masahiro Yokota, Sharp, *In Re TFT-LCD (Flat Panel) Antitrust Litigation*, No. M 07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, March 11, 2009, p. 109 (“Q: Did Sharp Corp have occasion to purchase panels or modules from other manufacturers for use in any of the LCD products we have been talking about? A: Yes, we have. Q: And from what manufacturers? A: The manufacturers, such as AUO or CMO.”).

⁶³ I understand (and assume for purposes of this report) that the allegations concern a conspiracy to fix the prices of LCD panels only, and not to fix the prices of products containing LCD panels.

⁶⁴ Deposition of Mohan Rao, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 07-1827-SI, in the United States District Court, Northern District of California, San Francisco Division, January 26, 2012, p. 135.

⁶⁵ Expert Report of Dennis W. Carlton, pp. 129-132.

the difficulties associated with efforts to collude in complex technology markets over a long period of time.

55. By contrast, despite his extensive citation to documents concerning efforts by the alleged conspirators to fix prices, there is no analysis of these basic economic criteria apparent in Dr. Rao's report. Based on my review of industry facts, and my review of Professor Carlton's and Dr. Rao's expert opinions, I find that Dr. Rao's estimated overcharges are inconsistent with these facts and apply overcharges calculated by Professor Carlton in the rest of my analyses.

VI. REQUIREMENTS FOR EMPIRICAL ANALYSIS OF MARK-UPS IN THE LCD INDUSTRY CONTEXT

56. In this section, I turn to the potential mark-up of overcharges in Dell's purchase of monitors from certain defendants. I explain why empirical analysis of mark-ups is needed and provide guidance as to how such analysis should be done to meet scientific standards. This guidance takes into account factors in the LCD industry context, i.e., differences in product quality, product innovation, and short and overlapping product cycles.
57. At a general level, prices and costs are related in a market economy, but specific market prices of goods and services are a function not only of costs. In the model of perfect competition – large numbers of identical firms – economic theory predicts 100 percent of costs will be passed on in the long run, i.e., over a time period sufficient for entry and exit.⁶⁶ In the more general model of competition, mark-up or pass-on rates are determined by the relevant elasticities of demand and supply.⁶⁷ Thus more generally, in long-run equilibrium,

⁶⁶ Harris, Robert G., and Lawrence A. Sullivan, "Passing on the Monopoly Overcharge: A Comprehensive Policy Analysis," *University of Pennsylvania Law Review*, Vol. 128(2), December 1979, pp. 292-293. Over more reasonable time horizons, the formula for determining the "rate of pass-on" (RPO) is:

$$RPO = \frac{e_s}{e_s + e_D}$$

where e_s denotes the elasticity of supply, and e_D denotes the absolute value of the elasticity of demand.

⁶⁷ George Kosicki, Miles B Cahill, *Economics of cost pass through and damages in indirect purchaser antitrust cases*, Antitrust Bulletin; Fall 2006 Vol. 51, No. 3, pg. 609. Plaintiffs' proffered expert Professor Marx recognized in her deposition that "...economics teaches us that pass-through rates tend to be related to the demand for the product and the nature of competition in the market..." See Deposition of Leslie M. Marx, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 07-m-1827 SI, MDL No. 1827, In the United States District Court, Northern District of California, San Francisco Division, February 7, 2012, (hereafter "Deposition of Leslie Marx, February 7, 2012"), p.162.

mark-up rates can be substantially lower than 100 percent. In the model of monopoly with linear demand, theory predicts 50 percent pass-on of cost increases. Of importance in this context, there is no guiding theory of how small numbers of rival firms set prices or react to changes in costs, much less how they will do so when vertically integrated and competing against firms that are not vertically integrated.⁶⁸ Consistent with the lack of guiding theory, empirical research shows that individual firms in such settings make different decisions whether to pass on cost increases at different points in time and under different circumstances.⁶⁹

58. Sound economic analyses of mark-up in particular industries differ from more general showings of positive relationships between prices and costs. Scientifically sound analyses of mark-up should isolate whether and to what extent changes in costs, including those due to alleged overcharges, cause a vertically-integrated manufacturer to change its prices on finished LCD products. A typical analysis of panel data matches the costs incurred by a manufacturer, to the prices it charges its customers at specific points in time. With these matched cost and price data, it is possible to pose the fundamental question: When the manufacturer experiences changes in costs, how does it adjust its downstream prices?
59. In the balance of this section, I will explore how industry factors affect demand, pricing and ultimately the measurement of mark-ups. Most fundamentally, product quality differs and the relative appeal of products changes within their product cycles as a result of the rapid pace of technological improvements in LCD panels and finished LCD products. If empirical

⁶⁸ There are many specific theories of so-called oligopoly pricing, e.g., Stackelberg, Cournot, Bertrand, but these various theories yield different predictions about pricing. In many real-world settings, marginal costs of products are low and even approach zero, but prices are substantial. A December 2009 European Commission report noted that "...[r]esults that are in between perfect competition [100 percent pass-on] and monopoly [50 percent pass-on] are typically obtained in oligopolistic markets." The same report reviewed empirical studies finding industry pass-on rates in the U.S. of between 73 and 103 percent. See Kominos, Assimakis, et al., "Quantifying Antitrust Damages: Towards Non-binding Guidance for Courts," Study Prepared for the European Commission, December 2009, <http://ec.europa.eu/competition/antitrust/actionsdamages/>, p. 118.

⁶⁹ Nijs, Vincent, et al., "Channel Pass-Through of Trade Promotions," *Marketing Science*, July 23, 2009, pp. 8-9; Abbritti, Mirko, "Incomplete Pass-Through in a Model of Retailers-Wholesalers Relationship," Working Paper, *Universidad de Navarra*, December 2010; See also, Nakamura, Emi, "Pass-Through in Retail and Wholesale," *American Economic Review*, American Economic Association, Vol. 98(2), May 2008, pp. 430-437; Gopinath, Gita, and Oleg Itskhoki, "In Search of Real Rigidities," *NBER*, Working Paper No. 16065, June 2010.

analysis of mark-up does not account for these and other fundamental characteristics of the finished LCD products industry, then the obtained results will not be accurate.⁷⁰

A. Finished LCD monitors and other large-panel products are characterized by differentiation and rapid, overlapping cycles of product introductions

60. Finished LCD product manufacturers combine innovative components along with the LCD panel to create televisions, notebooks, and monitors using large and medium LCD panels. Like LCD panels, these finished LCD products have short product cycles typically less than 24 months. As a result of innovations, product quality varies across products and relative product appeal changes over the life of each product.⁷¹ The discussion that follows will demonstrate clearly that incorporating product differences and product cycles is critically important to empirical analysis of mark-ups, as these factors will affect the prices of finished LCD products.
61. This pattern of innovation is common across many manufacturers of finished LCD products and affects the prices of products that include the innovation but also of products from previous generations that do not. In Exhibits 6.1-6.3, I present the number of new product models introduced by leading manufacturers in each of the large-panel product categories (monitors, TVs, and notebooks). The degree of differentiation among these models varied from firm to firm, but the pattern is clear. These innovations in turn make prior generations of products obsolete.⁷²
62. TFT-LCD panels are used in monitors, as are Cathode Ray Tube (CRT) displays.⁷³ Exhibit 7 presents the quarterly revenues associated with sales of LCD monitors from 1999 to 2006, as well as an index of monitor prices over this period using DisplaySearch data. Through the period, the monitor price index declined by more than 86 percent.

⁷⁰ Professor James Levinsohn has formally demonstrated the likely biases extant in the approaches used by the plaintiffs' experts. See Expert Report of James Levinsohn, Ph.D., *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. C07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, February 23, 2012, (hereafter "Expert Report of James Levinsohn"), pp. 12-19.

⁷¹ I use "relative appeal" to indicate where a product's perceived quality changes relative to alternatives, even where the characteristics of the product itself do not change.

⁷² Innovation by competitors has a similar impact. "Of course, a given innovation is followed not only by direct imitators and price competition but by further innovation by others and by the original innovator. These, in turn, tend to make the first innovation obsolete." Fisher, Franklin M., John McGowan, and Joen Greenwood, *Folded, Spindled and Mutilated: Economic Analysis and U.S. vs. IBM*, The MIT Press-Cambridge, 1983, p. 34.

⁷³ Franklin, Eric, "Monitor Buying Guide," *CNET*, April 6, 2011, http://reviews.cnet.com/2719-7610_7-200-1.html?tag=, visited on July 2, 2011.

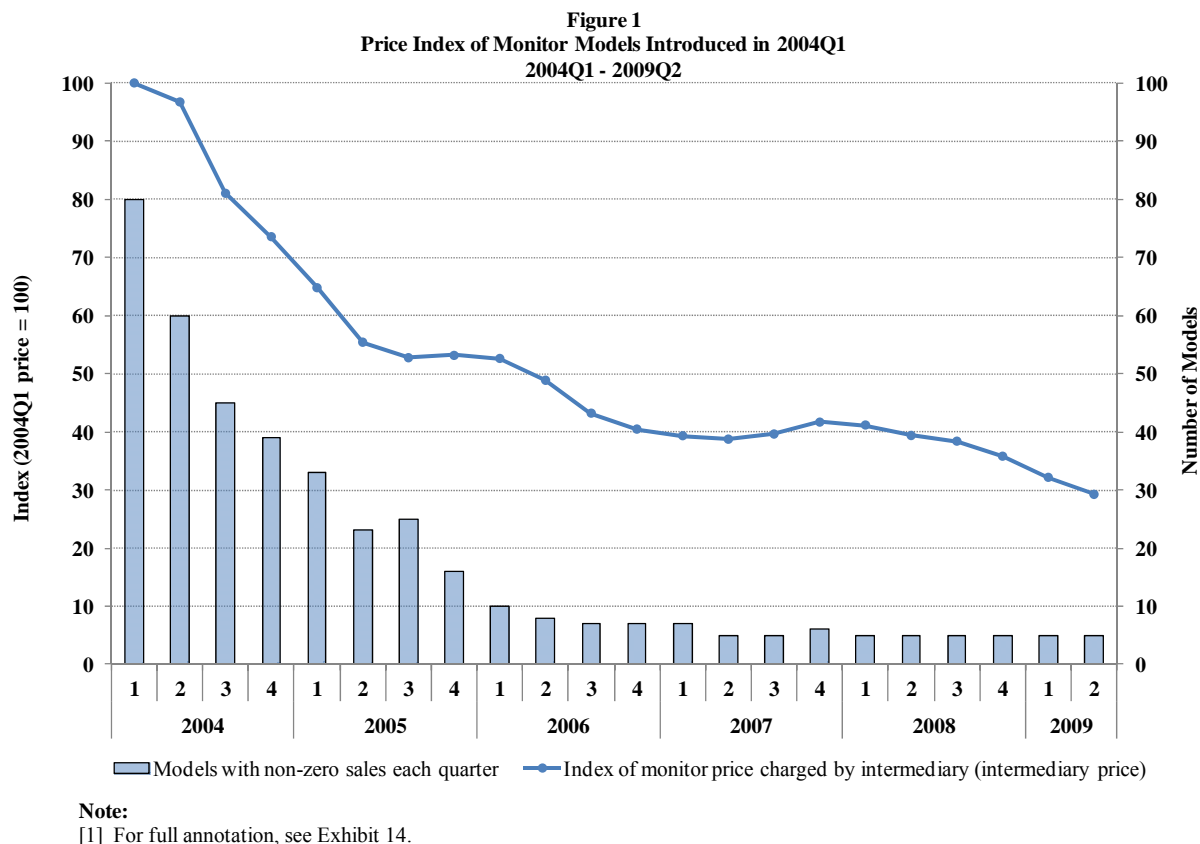
63. While estimates vary, I have calculated the LCD panel cost as a share of monitor prices to be in the range of 49 to 52 percent.⁷⁴ Of note, several non-display features differentiate monitors, including size and weight, power consumption, and interfaces.^{75,76} Exhibit 8 compares selected leading monitors sold by two brand-name OEMs (HP and Samsung). More specifically, Exhibit 8 identifies a variety of monitor features for monitors that have identical screen sizes and resolutions based on product reviews. These products differ, however, on several other dimensions. For example, the Samsung SyncMaster 712N and 730B each exhibit lower power consumption (34W) than the HP Pavilion vs17 and f1703 (47 and 50W). The Samsung products are also lighter (9.7 and 7.9 lbs., versus 11.7 and 12.1 lbs.), and offer greater brightness (300cd/m² compared with 250 cd/m²) and a higher contrast ratio (600:1 compared with 450:1 and 350:1) than the HP products.
64. In general, the product cycles of monitors are short, and prices decline steadily from the introduction of a product. For instance, I evaluated 1,597 monitor models in data produced by five defendants and third parties, including Dell, as well as one of the defendants, Samsung. For these products, the product cycle averages 4.1 quarters, and after two years, 90 percent of models show no sales. Figure 1 shows summary data for a subgroup of 80 monitors from these data that were introduced in the first quarter of 2004. This represents the largest number of monitors introduced in a quarter during the damages period. For these 80 products, I calculated an index of weighted average quarterly price changes over their product cycles,⁷⁷ and I also calculated the number of models with non-zero sales in each quarter.

⁷⁴ Expert Report of Edward A. Snyder, Ph.D., and Supporting Materials, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. C07-1827 SI, MDL No. 1827, United States District Court, Northern District of California, San Francisco Division, August 10, 2009 (hereafter “Snyder Expert Report, August 10, 2009”), p. 17.

⁷⁵ See, for example, “Dell UltraSharp U2711 Specs - LCD Monitors - CNET Reviews,” *CNET*, http://reviews.cnet.com/lcd-monitors/dell-ultrasharp-u2711/4507-3174_7-33913833.html?tag=lwrspecs, visited on July 2, 2011.

⁷⁶ Typical digital interface standards for monitors might include Digital Visual Interface (DVI), Universal Serial Bus (USB) and High-Definition Multimedia Interface (HDMI). Analog interface standards include radio-frequency coaxial cable, S-Video and VGA. See, for example, “DVI vs. HDMI vs. Component Video-Which is Better?” *Ecoustics.com*, February 14, 2005, <http://www.ecoustics.com/electronics/products/articles/122868.html>.

⁷⁷ The method used to calculate the price index for these products is a Fisher price index, which calculates the weighted average change in price across models.



65. Two conclusions are clear. First, of the 80 models, almost half show sales for only three quarters, and one fourth show only one quarter of sales. In fact, while not displayed on the chart, the average unit sales of these 80 models peaks in its first quarter. Second, prices fall steadily after the first quarter. By the second quarter of 2006, only 10 percent of models continue to have positive sales, and prices have declined by almost 50 percent. While the product cycles of individual models vary, this pattern indicates that a product's peak appeal is at (or near) the beginning of its product cycle and that diminished relative product quality over the course of the product cycle is associated with falling product prices.

66. Similar differentiation and product cycles can be observed in other products that feature large LCD panels. In Exhibit 9, I compare four leading notebook computers sold by two brand-

name OEMs (HP and Toshiba) with comparable display characteristics.⁷⁸ Other attributes, such as the microprocessors (CPUs) differ. The HP Pavilion ze4930 and the Toshiba Satellite A65 featured Intel's Celeron processor brand targeted at value consumers. The HP Pavilion zv6233NR included an AMD Athlon 64 CPU and the Toshiba Satellite A105 used Intel's Core Solo microprocessor; both of these CPUs represent significant upgrades from the Celeron brand.⁷⁹

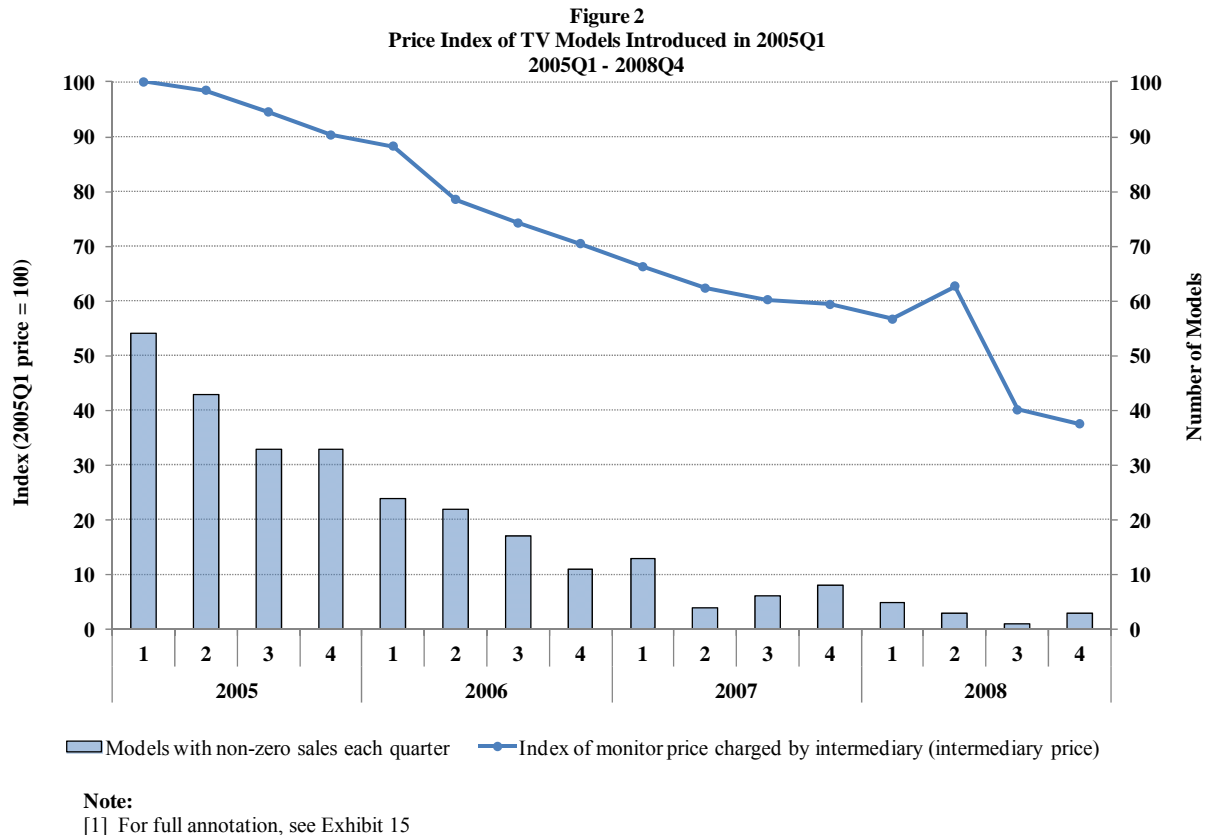
67. Exhibit 10 presents summary data on two top-selling Samsung and Sony display televisions with similar display characteristics,⁸⁰ but with differing other characteristics and features. For example, the Sony Bravia KDL-V32XBR1 included a digital tuner and additional sound output (26 watts vs. 20 watts for the Sony Bravia KLV-S32A10). I note that the weighted average price and the minimum and maximum prices observed for the Bravia KDL-V32XBR1 were higher than the Bravia KLV-S32A10.
68. Televisions show a similar product cycle to monitors. Figure 2 presents an index of weighted average quarterly price changes for the 54 television models in Professor Bernheim's dataset introduced in the first quarter of 2005.⁸¹ Again, I also calculate the number of models with positive sales in each quarter. Consistent with the example in Figure 1, Figure 2 demonstrates that the product cycles for LCD TVs are also short, with less than one-half of models remaining after just five quarters, and only a handful of models remaining after 10 quarters. Prices decline steadily over the life of the model.

⁷⁸ These products were all identified from transaction data produced by Best Buy. The notebooks had either a 15 inch or 15.4 inch LCD display. Two had resolutions of 1024 by 768 pixels, and two had resolutions of 1280 by 800 pixels.

⁷⁹ "Laptop Buying Guide," *CNET*, http://reviews.cnet.com/4520-7602_7-1016082-3.html?tag=bg;bg_l, visited on July 12, 2011; "AMD Athlon 2000+ Processor vs. Intel ULV Celeron M 423 Flyer," *AMD.com*, www.amd.com/us/Documents/45867A_Athlon_2000_vs_M423_Flyer.pdf, visited on July 12, 2011.

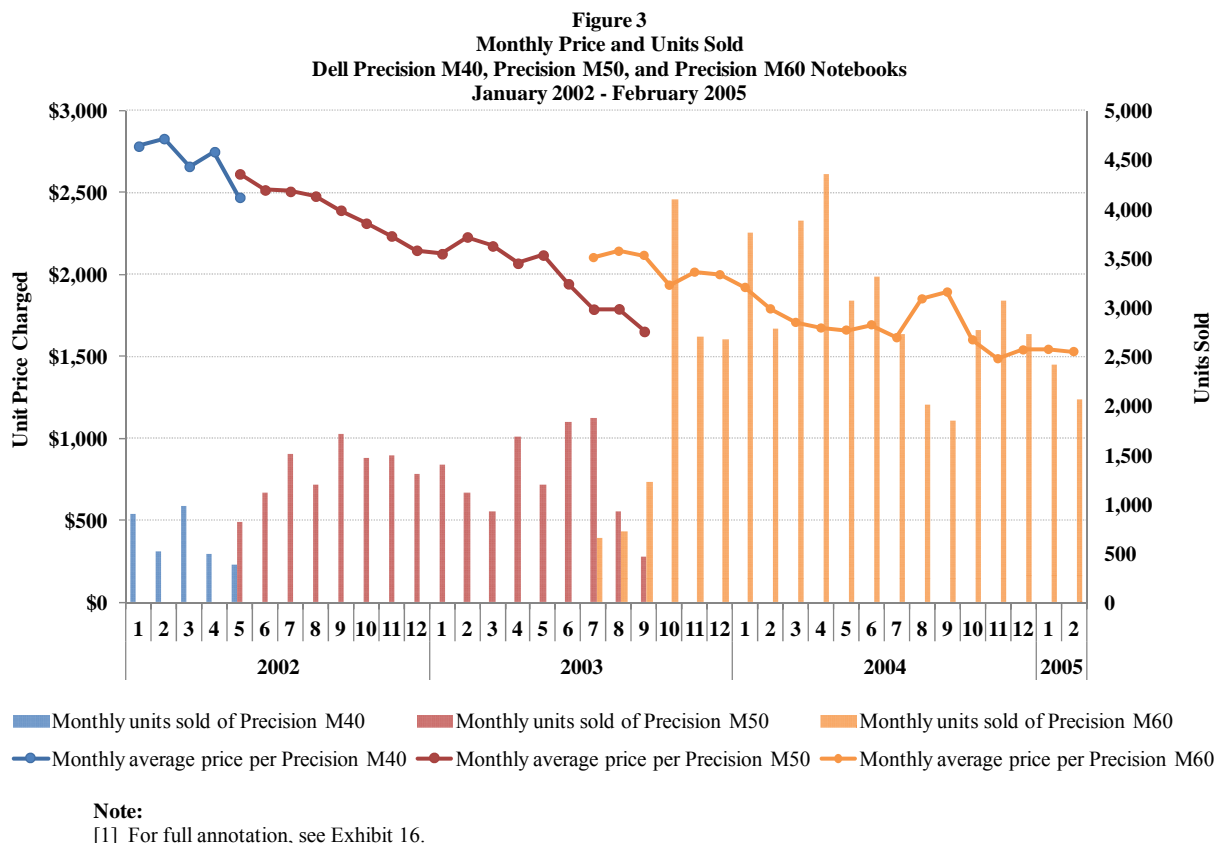
⁸⁰ "Sony KLV-S32A10 Specs," *CNET*, http://reviews.cnet.com/flat-panel-tvs/sony-klv-s32a10/4505-6482_7-31304867.html?tag=rnav, visited on July 7, 2011; "Sony Bravia KDL-V32XBR1 – CNET Reviews," *CNET*, http://reviews.cnet.com/flat-panel-tvs/sony-bravia-kdl-v32xbr1/4505-6482_7-31470105.html?tag=mav, visited on July 7, 2011.

⁸¹ This quarter had the largest number of television model introductions in Professor Bernheim's dataset.

Highly Confidential – Subject to Protective Order

69. Figure 3 presents summary data on successive generations of the Dell Precision notebook (M40, M50 and M60) and thereby helps generate insights regarding the nature of overlapping product cycles. As indicated in Figure 3, average prices decline throughout the product cycle of each model. While the M50s sold at nearly \$2,500 per unit at the beginning of its introduction, a year later average prices were approaching \$1,500. At that time, the next generation M60 was introduced.

70. It is clear from the evidence in Figure 3, which is representative of the patterns associated with overlapping product cycles, that any empirical analysis of mark-ups should account for the likely influence of these factors on finished LCD product prices.

Highly Confidential – Subject to Protective Order

B. Declining relative quality over the product cycle

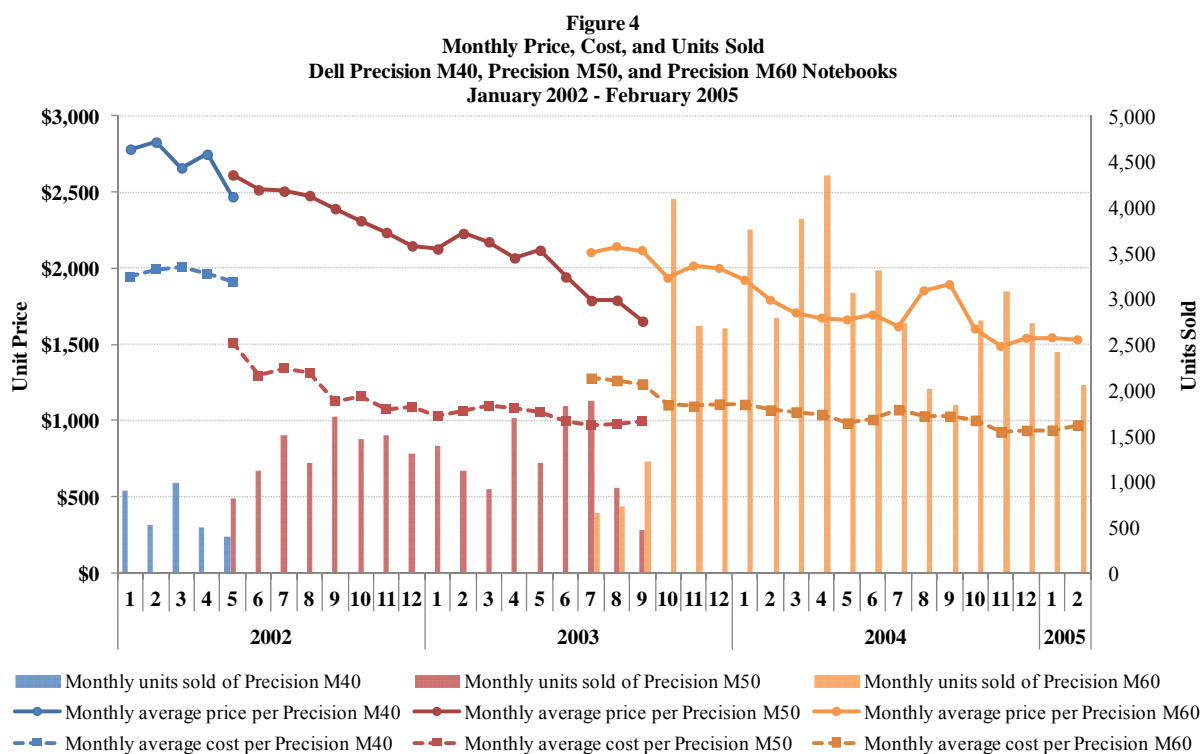
71. Not surprisingly, mark-up decisions cannot be distilled down to the influence of a single factor on price and they cannot be fully characterized with evidence on the behavior of a single firm. Many OEMs distribute a large portfolio of products with significant variation in features and characteristics. For example, the Inspiron 15, a Dell notebook product, had more than 40,000 possible configurations.⁸² Moreover, there is no single factor that determines what the prices of finished LCD products will be or how it will change. Product cost, competition, supply factors and an OEM's financial plan all combine to inform the decision makers at a particular firm who determine how prices will change.⁸³ Manufacturers combine innovations to differentiate their products, attempting to capitalize on demand for leading products. As a result, differences in prices across products may reflect differences in

⁸² Declaration of Shane Gregorczyk, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. M07-1827 SI, MDL. No. 1827, United States District Court, Northern District of California, San Francisco Division, June 25, 2009 (hereafter "Declaration of Shane Gregorczyk, February 23, 2010"), p. 2.

⁸³ Declaration of Shane Gregorczyk, February 23, 2010, p. 2.

the perceived quality of alternatives that include (or do not include) these innovations, rather than differences in manufacturing costs. However, to the extent that these changes in perceived quality change with changes in cost, any appropriate analysis of mark-up must differentiate the potentially separate effects of quality and costs on prices.

72. The rapid introduction of new, innovative technologies to differentiate products that contain LCDs along with decreases in the cost of components (including panels) helped to create strong downward trends in the prices of finished LCD products in the relevant period. As a result of these technological trends, manufacturers competed to differentiate their products using features to make other products (and sometimes, their own products) obsolete. Product cycles were very short; an analysis of data in this case suggests that the typical product cycle was less than two years. Figure 4 presents the product cycle of the same Precision M40, M50 and M60 Dell notebooks that I discussed above.⁸⁴



Note:

[1] For full annotation see Exhibit 17.

⁸⁴ I note these models are often differentiated even further; for example, there are 3 different models (Dell-220-5077, Dell-461-3065, and Dell-7K156) within the Precision M40 brand.

73. The product cycle for each of these products is approximately one year; each product is introduced towards the end of the cycle of the previous model. It cost Dell less to make the M50 as the prior M40; at introduction, the cost of the M50 was \$1,500, whereas the M40 cost closer to \$2,000 per unit. However, at introduction, Dell charged customers prices close to \$2,500 for both units, even though the now-obsolete M40 cost more to make. Similarly, when the M60 was introduced in mid 2003, prices of the M50 declined, even though the cost of the product stayed the same or increased. The introduction of the newer, more innovative product made it difficult for Dell to raise the prices of older products, even if it would have liked to pass along cost increases for such products
74. These examples illustrate how factors other than cost drove changes in prices during the period at issue. While a number of factors were in play, overlapping product introductions causes declines in the relative product quality of the model during the product cycle. In fact, this phenomenon has been explored in the literature on so-called “durapologists” or sellers of differentiated, durable goods facing downward-sloping demand curves:

Many new products, like books and consumer electronics, are very expensive when they first appear on the market; over time, their prices decline. In many cases, prices go down with the appearance of newer products that undermine the appeal of older products. In other cases, the decline constitutes intertemporal price discrimination: Early shoppers are charged more than late shoppers. Indeed, a declining price path may be a well-crafted strategy of durapologists rather than time-inconsistent behavior. When such a strategy is properly devised, the durapologist’s profits are higher than under a regime of a constant monopoly price. A planned declining price trajectory, often referred to as price skimming, is based on price discrimination among consumers according to their price-time sensitivity. Time-sensitive consumers are willing to pay premia to receive products immediately. Such consumers know that prices will decline but, nevertheless, are too impatient to postpone purchases. In contrast, price-sensitive consumers are unwilling to pay the premia charged early shoppers, so they delay purchases until prices are low. Recognizing the existence of different sets of consumers, a durapologist can maximize profits by pursuing a declining price path.⁸⁵

These products may include new innovative technologies that so-called “early adopters” want and are willing to pay significantly higher prices for. As products mature, substitutes may emerge and novelties wear off; prices decline. When products approach obsolescence, manufacturers may sell them at or even below cost. In fact, in her deposition, Professor

⁸⁵ Orbach, Barak Y., “The Durapologist Puzzle: Monopoly Power in Durable-Goods Markets,” *Yale Journal on Regulation*, 21: 67 – 118, 2004.

Marx acknowledged that the product cycle observed in this matter is consistent with price discrimination strategies described in this literature.⁸⁶ Yet, Dr. Rao did not consider whether this phenomenon can and does occur without a significant change in the manufacturing cost, and did not develop a method to account for it.

75. In fact, several authors have noted that the demand for particular finished LCD products such as digital cameras and LCD TVs declines at the same time as manufacturing cost may decline also. This relative quality effect and the accompanying pricing policies that businesses employ to take advantage of it, must be distinguished from the relationship between cost and price, if relative quality and cost are correlated; both are moving downward over the product cycle. For example, one analysis found that for digital cameras:

cost reduction is not the only factor that drives down product prices in new durable goods markets. Markups may decline at the same time as costs and account for part of the price declines. The reasons for declining markups are multiple. Intensifying price competition over time may be a generically plausible explanation, but the unique features of durable goods markets imply another even more important one - the interaction between the dynamic behavior on the demand and supply sides of the economy.⁸⁷

76. Similar findings have been derived from analyses of other products featuring LCD displays.⁸⁸ Economics textbooks have noted the importance of this relationship between prices and quality to finished LCD products and other consumer electronics, noting that:

The prices of new electronics products also come down over time because costs fall as producers start to achieve greater scale economies and move down the learning curve. But even if costs did not fall, producers can make more money by setting high prices and then reducing them over time, thereby discriminating and capturing consumer surplus.⁸⁹

77. The fundamental insight here is that declining prices may be driven by declining relative quality for these differentiated durable goods, as well as by declining costs of producing the

⁸⁶ Deposition of Leslie Marx, February 7, 2012, p. 218.

⁸⁷ Zhao, Ying, "Why are Prices Falling Fast? An Empirical Study of the US Digital Camera Market," Working Paper, Yale University, November 2006, p. 2. See also, Lou, Weifang, David Prentice, and Xiangkang Yin, "What Difference Does Dynamics Make? The Case of Digital Cameras," *International Journal of Industrial Organization*, Vol. 30, 2012, pp. 30-40.

⁸⁸ Conlon, Christopher, "A Dynamic Model of Costs and Margins in the LCD TV Industry," Working Paper, Yale University, November 2010; Gowrisankaran, Gautam and Marc Rysman, "Dynamics of Consumer Demand for New Durable Goods," NBER Working Paper No. 14737, October 2011.

⁸⁹ Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics*, 7th Edition, Chapter 11, footnote 9.

product. As Professor Levinsohn explores more formally in his report, failure to account for product-cycle effects in an empirical analysis of mark-ups means the estimated mark-up will likely be biased upwards.⁹⁰ In the next section, I will explain that the analysis of mark-up presented by Dr. Rao are likely subject to this bias.

VII. EVALUATION OF DR. RAO'S ANALYSIS OF MARK-UP AND DAMAGES

78. Dell claims it was damaged on purchases of computer monitors that it made directly from two vertically-integrated defendant manufacturers, Samsung and LG.
79. The logic of Dell's claim is that Samsung and LG charged Dell more for monitors because of an alleged conspiracy to fix the prices of panels. That is, Samsung and LG charged themselves "overcharges" for their own panels, and subsequently maintained these overcharges in the prices of the monitors that they sold to Dell.
80. Consider, for example, Samsung and LG's incentives not to charge themselves "overcharges" for their own panels, but rather to set the prices of their monitors based on their actual costs of manufacturing the LCD panels. Doing so would give them a price advantage vis-à-vis non-integrated manufacturers of computer monitors who are allegedly purchasing panels at an overcharge. Samsung and LG would, in effect, be deviating from the alleged panel conspiracy by not charging themselves an inflated panel price.
81. This price advantage would potentially enable Samsung and LG to sell more computer monitors at the expense of non-vertically-integrated manufacturers of computer monitors, and non-vertically integrated panel manufacturers would, presumably, experience a decrease in demand for their panels. If this decrease in demand was substantial enough, and if the non-vertically-integrated LCD panel manufacturers were able to connect the decrease in

⁹⁰ Professor Bernheim, the Plaintiffs' expert in a related matter, testified in deposition that changes in the prices of innovative products over their product cycles can reflect "strategic pricing decision[s] on the part of the company to introduce at a higher price and lower it," and that "there are decisions that companies make when they're introducing particularly innovative products to introduce them at higher markups and then reduce those markups." (Deposition of B. Douglas Bernheim, *In Re: TFT-LCD (Flat Panel) Antitrust Litigation*, No. 3:09-cv-05840 SI, In the United States District Court, Northern District of California, San Francisco Division, January 31, 2012, (hereafter "Deposition of B. Douglas Bernheim"), Volume II, p. 52) Professor Bernheim also testified that changes in the price of a product could reflect changes in demand for the product over its product cycle and that changes in demand for a product over its product cycle could be a confounding factor if it varied in a particular way. (Deposition of B. Douglas Bernheim, January 31, 2012, Volume II, pp. 52-53) One such "particular way" is if demand weakens and cost falls over the product cycle.

demand to the fact that Samsung and LG were not charging themselves overcharges on the panels they were using in their computer monitors, the non-vertically-integrated LCD panel manufacturers could try to punish Samsung and LG from having deviated from the panel conspiracy. This punishment would then, presumably, prevent Samsung and LG from deviating from the panel conspiracy in the first place. However, it is unlikely that the non-vertically-integrated LCD panel manufacturers could detect such deviations from the alleged panel conspiracy, particularly in the absence of an agreement to fix prices of finished products. Samsung and LG could charge lower prices than non-vertically-integrated manufacturers of computer monitors for any number of reasons. The non-vertically-integrated LCD panel manufacturers would have very little ability to determine whether Samsung and LG were charging lower prices for computer monitors because they were not overcharging themselves, or because they were becoming more competitive for some other reason, or because the non-vertically integrated monitor manufacturers were becoming less competitive for some other reason. Absent an ability to enforce the alleged panel conspiracy, the incentives for Samsung and LG to deviate from the alleged conspiracy by not charging themselves overcharges on their own panels would have been strong.

82. In this context, Dr. Rao first purports to estimate an overcharge for panels sold by defendant manufacturers, then apparently purports to show in a “sensitivity analysis” that the vertically-integrated defendant manufacturers charged themselves overcharges on panels that they “sold” to themselves internally.⁹¹ He then purports to show that if the defendant manufacturers had charged themselves overcharges, they would have behaved as if their costs were higher by the full amount of the self-imposed overcharges, causing them to charge more for the monitors that Dell purchased.

83. I have been asked to calculate the extent to which Samsung and LG charged Dell higher prices for computer monitors because they purportedly charged themselves higher prices for the panels used to manufacture those monitors, and to apply the estimated rate to the overcharges calculated by Professor Carlton to arrive at an estimate of damages.

84. Economic theory does not provide specific guidance about the rate at which a vertically-integrated manufacturer would “mark-up” the price of a finished product as a result of a self-

⁹¹ Expert Report of Mohan Rao, pp. 47-48.

imposed overcharge on the price of an input. Hence, I have reviewed Dr. Rao's empirical work to determine whether he correctly isolated the effect of internal panel prices on the prices charged to Dell for computer monitors. In particular, I reviewed whether Dr. Rao used econometric methods that are appropriate to the task of estimating the rate at which the prices of Dell computer monitors were affected by the prices that Samsung and LG charged themselves for LCD panels.

A. Overview of Dr. Rao's approach to estimating mark-ups

85. Dr. Rao aggregates data on Dell monitor purchases at the quarterly level, and calculates the weighted average quarterly price. He then regresses this price on quarterly average panel prices from DisplaySearch data, lagged one quarter to account for the delay in incorporating a panel into a finished LCD monitor. Dr. Rao does not control for the prices of any other inputs used to make computer monitors,⁹² though in a sensitivity analysis he includes a measure of OECD GDP or the U.S. personal consumption expenditure index for personal computers to account for other drivers of demand. In a separate sensitivity analysis, Dr. Rao also uses LG and Samsung panel cost data in place of the DisplaySearch data.⁹³ To be "consistent with prior academic research on pass-through rates," Dr. Rao utilizes a first-differences approach.
86. Dr. Rao estimates that mark-ups range from 100 to 109 percent and concludes based on these findings that 100 percent of changes in the prices that Samsung and LG charged themselves for panels are reflected in the prices that Samsung and LG charged Dell for monitors. Thus, Dr. Rao concludes that "Overcharge damages to Dell on its direct purchases of monitors are, therefore, calculated as equal to the calculated overcharge on the corresponding panel."⁹⁴
87. Below, I will review three errors in Dr. Rao's analysis:
- i. Despite his use of "first differences" to control for differences in quality across products, Dr. Rao does not adequately control for changes in relative product quality for Dell monitors over time. If changes in the relative appeal of monitor models independently affect the prices that Samsung and LG charge Dell for computer monitors, and these changes are positively correlated with the changes

⁹² Expert Report of Mohan Rao, pp. 44-46.

⁹³ Expert Report of Mohan Rao, pp. 46-48.

⁹⁴ Expert Report of Mohan Rao, p. 47.

- in prices that Samsung and LG charged themselves for panels, Dr. Rao's estimates can be expected to be biased upward.
- ii. Dr. Rao does not control for changes in prices of other inputs that are used to make finished LCD monitors. If the prices of other inputs affect the prices that Samsung and LG charge Dell for monitors, and if the prices of these other inputs are positively correlated with the prices that Samsung and LG charge themselves for panels, Dr. Rao's estimates can be expected to be biased upward.
 - iii. Dr. Rao excludes a substantial amount of relevant data and ends up estimating the mark-up rate using a sample of only 40 observations.

B. Dr. Rao's mark-up analysis fails to control for changes in product quality over product cycles

88. Dr. Rao's estimates of "mark-up" is expected to be biased upward if Dell's demand for monitors is positively correlated with the prices that Dell paid for monitors and the prices that Samsung and LG charged themselves for panels.
89. Dr. Rao implicitly acknowledges this concern and attempts to control for demand by including a measure of OECD GDP in one "sensitivity" analysis and a measure of the personal consumer expenditure index for personal computers ("PCE") in another "sensitivity" analysis.⁹⁵
90. The problem is that these two variables are highly aggregated macroeconomic proxies of demand, that may capture the effects of changes in general economic activity, but are poor proxies for Dell's demand for a specific type of monitor. For example, Dr. Rao's estimated coefficient on the effect of OECD GDP is very small. In addition, Dr. Rao's estimated coefficient on the effect of the personal consumption expenditures index is not significantly different from zero. These results suggest that OECD GDP and the personal consumption expenditures index are poor predictors of demand-driven changes in the prices of LCD monitors, in part because they are only weakly related to the underlying demand for monitors that must be controlled for.
91. As I demonstrated in Section VI, LCD monitor prices – including those manufactured by defendants such as Samsung – exhibit a strong "product cycle" effect, reflecting changes in demand over the life of the model. Dr. Rao's inclusion of OECD GDP and a personal

⁹⁵ It is worth noting in his sensitivity analysis that uses panel costs from LG and Samsung internal sales data, Dr. Rao did not include the OECD GDP or PCE variables to control for demand.

consumption expenditure index are likely to be inadequate controls for these product cycle effects.

C. Dr. Rao's mark-up analysis fails to isolate the impact of panel cost changes on finished product price changes

92. Dr. Rao's estimate of mark-up can be expected to be biased upward if changes in inputs used to make LCD computer monitors are positively correlated with changes in the prices that Samsung and LG charged themselves for panels.⁹⁶ The cost of an LCD panel is only one component of the cost of producing finished monitors that were sold to Dell. There are many other components of a monitor, such as a power inverter and microcontroller as well as wages and distribution costs. If the prices of these inputs move together (i.e., if the prices of the microcontroller, power inverter, and LCD panel decrease over time), then Dr. Rao's mark-up analysis may mistakenly attribute a decrease in the price of these components to a decrease in the price of a panel, thus inflating the estimate of mark-up in his analysis. As I described in the exhibits accompanying Section VI, there are a variety of non-display characteristics that firms incorporate into finished monitors and that affect prices. It is therefore critical that any regression method account for these differences to measure mark-up.

D. Dr. Rao's mark-up analysis excludes much of the relevant data

93. Dr. Rao's analysis of mark-up uses data from the second quarter of 2002 to the fourth quarter of 2004, even though data are available through the second quarter of 2006. By limiting his analysis to these dates, Dr. Rao excludes 13 observations, or the equivalent of 1,826,503 units of monitors purchased by Dell. By excluding much of this relevant data, Dr. Rao's mark-up analysis relies on only 40 observations. Other than the fact that his model yields negative overcharges between 2005 and 2006, Dr. Rao offers no justification for why the post-2004 data would not be relevant to the question of mark-up.⁹⁷

⁹⁶ As a general matter, this omission results in a statistical problem that is commonly referred to as omitted variable bias. See Wooldridge, Jeffrey M. South-Western, *Introductory Econometrics: A Modern Approach*, Second Edition, Thomson SouthWestern, 2003, pp. 89-93.

⁹⁷ Deposition of Mohan Rao, p. 126; Expert Report of Mohan Rao, pp. 41-42.

VIII. AFFIRMATIVE ANALYSIS OF MARK-UP AND DAMAGES

94. My analytical framework for evaluating damages to Dell included at least two conditions that must be met. First, overcharges caused by the cartel must have been embedded in the prices of LCD panels incorporated by vertically-integrated defendant manufacturers into relevant finished monitors. Second, these overcharges must have been passed on (in total or in part) in the price of the finished monitor when sold to Dell.

95. Professor Carlton has analyzed the claims of the Plaintiffs' proffered expert Professor Bernheim with regard to the overcharges, and has described significant flaws in the analyses put forward by Dr. Rao. Professor Carlton also offers his own affirmative analyses of the overcharges in this matter for large and small panels, and concludes that:

... my model yields an overcharge prediction of approximately 0.4 percent for notebook computers [...] I consider the estimate for notebook computers to be the best available proxy from my econometric models for other large panels (monitor and television panels), although a likely upper bound...⁹⁸

96. For the reasons described earlier, I have incorporated the estimates of overcharges at the LCD panel level provided by Professor Carlton. Given the available data, I have estimated mark-up rates to Dell. Fully consistent with the report provided by Professor Levinsohn, the overall methodology for estimating mark-ups should reflect an understanding of the salient features of the finished LCD product industries. These industries are dynamic and characterized by differentiated products whose relative quality and demand are affected by competition from newer, more innovative products, as demonstrated in Section VI. In this context, my mark-up analysis allows for separation of the effect of changes in these factors on prices.

97. I meet the critical goals of addressing differences in product quality and product cycle effects by estimating a regression in a *differenced* form as follows:

$$(price_{it} - price_{it-1}) = \alpha + \beta(cost_{it} - cost_{it-1}) + \mu_2 * d_{i2t} + \mu_3 * d_{i3t} + \mu_4 * d_{i4t} + (\varepsilon_{it} - \varepsilon_{it-1})$$

98. Specified in differences, this regression model accomplishes two goals. First, by calculating the difference between prices (costs) of product from one period to the next, I account for quality differences across products that are fixed over time. Second, even though it may not

⁹⁸ Expert Report of Dennis W. Carlton, pp. 129-132.

be obvious without some mathematical exposition, the constant α measures the effect of the product cycle on product prices. As such, the regression accounts for two key factors that must be accounted for to obtain an unbiased estimate of how changes in costs affect changes in prices.⁹⁹

99. My approach is similar to Dr. Rao's in that I first difference the data, but I have included a constant term, which he excluded from his specification. By including the constant, I address the concern that prices and costs are spuriously correlated due to strong trends in the data (including trends related to the product cycle effects described above).¹⁰⁰ As such, unlike Dr. Rao's specification, my approach recognizes the characteristics of the industry, and is specified to capture the unbiased effect of cost on price.¹⁰¹

100. I note that equation (6) in Professor Levinsohn's expert report represents a regression specification that is slightly different from the one above. This is because his regression allows each product to have its own "product cycle" trend." My specification adds a restriction to Professor Levinsohn's specification in that all products are modeled as sharing the same product cycle effect. I make this restriction because Professor Levinsohn's specification cannot be applied to products that are observed for only two quarters. All these products would be eliminated from my analysis absent the restriction. Professor Levinsohn explicitly describes this issue and proposes the functional form that I use and show in my equation above. He characterizes my estimation strategy as an appropriate estimation method when products are short-lived.

101. I have reviewed a number of studies from the econometric literature that analyzed the pass-on or marking up of costs in a variety of circumstances.¹⁰² Among the methods used to

⁹⁹ Expert Report of James Levinsohn, pp. 12-20.

¹⁰⁰ The constant α is what remains after differencing the "time-on-market" trend variable in a modified version of Professor Levinsohn's equation (5). I control for a product cycle trend that is common to all products, which enables me to avoid excluding many of the products that are on the market for a relatively short period of time. Thus, the constant α is a control for the effect of the product cycle on prices. The terms μ_2 through μ_4 refer to parameters that account for seasonal patterns that may affect prices.

¹⁰¹ In a regression model specified in differences, the constant is a control for factors such as product cycle that may affect the change in the price from one period to the next.

¹⁰² See, for example, Aaronson, Daniel, "Price Pass-through and the Minimum Wage," *The Review of Economics and Statistics*, Vol. 83(1), February 2001, pp. 158-169; Arbatskaya, Maria, and Michael R. Baye, "Are Prices 'Sticky' Online? Market Structure Effects and Asymmetric Responses to Cost Shocks in Online Mortgage Markets," *International Journal of Industrial Organization*, Vol. 22(10), December 2004, pp. 1443-1462; Burdette, Michael, and John Zyren, "Gasoline Price Pass-through," http://www.eia.doe.gov/pub/oil_gas/

evaluate pass-on and mark-ups in these and other papers, I note that many employ a differences methodology.¹⁰³

A. Upstream mark-up to Dell

102. As I've described in Section VII, Dr. Rao's mark-up analysis excludes much of the relevant data. I have therefore corrected Dr. Rao's data to include the full period for which DisplaySearch panel price data are available. In addition, by failing to include a constant term in his regression, Dr. Rao does not control for relative changes in product quality over product cycles. I have also corrected his model to include a constant that controls for changes in demand over these product cycles. When I make these corrections, Dr. Rao's mark-up estimate falls below 100 percent. The results of these analyses are presented in Exhibit 11. For finished monitors, the estimated upstream mark-up rate falls from 109 percent to 92 percent.

103. In addition, I have conducted studies of pass-on for monitors using data from three firms: Acer, Dell, and Westinghouse. Unlike Dr. Rao's method which analyzes the relationship between the change in the prices of finished LCD monitors and the cost of panels, these pass-on studies use my preferred method to analyze the relationship in the changes in prices of

petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm, *Energy Information Administration*, January 2003, visited on July 26, 2005; Campa, Jose Manuel and Linda S. Goldberg, "Exchange Rate Pass-Through into Import Prices," *The Review of Economics and Statistics*, Vol. 87(4), November 2005, pp. 679-690; Campa, Jose Manuel, and Linda S. Goldberg, "Pass Through of Exchange Rates to Consumption Prices: What Has Changed and Why?" *NBER*, Working Paper No. 12547, September 2006; Duffy-Deno, Kevin T., "Retail Price Asymmetries in Local Gasoline Markets," *Energy Economics*, Vol. 18, 1996, pp. 81-92; Knetter, Michael M., "International Comparisons of Pricing-to-Market Behavior," *The American Economic Review*, Vol. 83 (3), June 1993, pp. 473-486; Leibtag, Ephraim, et al., "Cost Pass-Through in the U.S. Coffee Industry," *USDA*, Economic Research Report No. 38, March 2007; Nakamura, Emi, and Dawit Zerom, "Accounting for Incomplete Pass-Through," *NBER*, Working Paper No. 15255, August 2009; Poterba, James M., "Retail Price Reactions To Changes In State And Local Sales Taxes," *National Tax Journal*, Vol. 49(2), June 1996, pp. 165-176; Rangan, Subramanian, Robert Z. Lawrence, and Richard N. Cooper, "The Responses of U.S. Firms to Exchange Rate Fluctuations: Piercing the Corporate Veil," *Brookings Papers on Economic Activity*, Vol. 2, 1993, pp. 341-379; Shin, David, "Do Product Prices Respond Symmetrically to Changes in Crude Prices?", *OPEC Review*, Vol. 18(2), 1994, pp. 137-157.

¹⁰³ I also note that in some cases, the estimation of a model that includes product fixed effects or the estimation of a model in first differences may lead to concerns about "attenuation bias" resulting from classical measurement error. Importantly, such potential concerns depend on the extent of classical measurement error in the data used in the estimation. In my analysis, I have averaged the data to the quarterly level and implemented the outlier removal algorithms used by Plaintiffs' experts in related matters to mitigate the statistical noise related to classical measurement error. Averaging the data to the quarterly level and removing outliers mitigates this noise. (See Expert Report of James Levinsohn, pp. 31-33; see also, Epstein-Frankel report, ¶ 49) I also note that estimation of the model in quarter-to-quarter differences reduces the concern that prices may not respond instantaneously to changes in cost.

finished monitors and the cost of finished monitors; therefore, they account for changes in manufacturing costs of other inputs into the monitor as well as the cost of the panel. My results from these studies show that pass-on for monitors varies from 35 percent to 91 percent. I have also calculated a “common” estimate of pass-on, using all of the data for finished monitors to estimate a single pass-on coefficient for monitors of 88 percent. To compute the mark-up to Dell, I take the simple average of the corrected version of Dr. Rao’s markup (92 percent) and my pass-on studies for finished monitors (88 percent) to derive an estimated mark-up of 90 percent.

104. The “100 percent” mark-up used by Dr. Rao is not supported by either economic theory, or Dr. Rao’s own method and data. As these results suggest, the data selected by Dr. Rao and the method preferred in the economics literature do not support a conclusion that overcharges would be fully passed on to Dell. Instead, they suggest that changes in panel prices are not entirely reflected in the pricing decisions of vertically-integrated defendants for finished monitors. Any estimate of damages from purchases of finished monitors should be reduced to reflect these results, if not discounted entirely for failing to meet the two conditions I outlined in Section IV.

B. Volume of sales and estimated damages

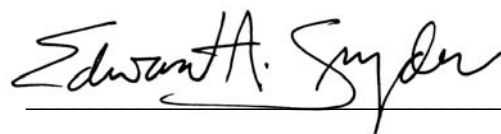
105. I have been asked to review Dr. Rao’s computation of the total dollar amount of finished monitors purchased by Dell from LG and Samsung during the alleged conspiracy period (I refer to this amount as the “volume of sales”). After adjusting for returns and rebates, Dr. Rao concludes that Dell purchased \$2.6 billion of finished monitors from LG and Samsung from October 2001 to 2004. I have reviewed Dr. Rao’s computation of the volume of sales and have adjusted his methodology to correct for a calculation error that understates the amount of returns. The corrected volume of sales is shown in Exhibit 12.
106. To calculate damages to Dell, I multiply the overcharges calculated by Professor Carlton by quarterly prices for each type of LCD panel, as compiled by Dr. Rao. The result is the estimated overcharge on each panel type. I multiply this panel overcharge by the corrected volume of sales of LG and Samsung finished monitors that I presented in Exhibit 12. I then multiply these amounts by my estimated mark-up rate of 90 percent. In Exhibit 13, I estimate Dell’s total damages on its purchases of finished monitors from LG and Samsung to be \$6.3 million.

IX. CONCLUDING REMARKS

107. Based on my analysis, I have reached the following three conclusions:
- i. Professor Carlton's estimated overcharges are more consistent with the facts of the LCD panel and finished LCD product industries, and provide a more plausible input to the calculation of damages.
 - ii. The appropriate mark-up for the calculation of damages is 90 percent. I calculate this mark-up rate using a method that takes into account the fundamental characteristics of the finished LCD product industry, namely intense innovation, product differentiation and short, overlapping product cycles.
 - iii. The total volume of sales for my calculation of damages is presented in Exhibit 12.
108. Taken together, these three findings indicate that damages are but a small fraction of those calculated by Dr. Rao. The damages I have calculated are summarized in Exhibit 13.

Highly Confidential – Subject to Protective Order

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 23, 2012 in New Haven, Connecticut.

A handwritten signature in black ink, reading "Edward A. Snyder", written over a horizontal line.

Edward A. Snyder